NINETEENTH YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

MICRO

Vol. IV. (Third Series)
No. XCVIII.

FEBRUARY
1882.

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LONDON:

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THE

JOURNAL OF SCIENCE.

FEBRUARY, 1882.

I. MIND-READING OR MUSCLE-READING.

OUR readers are of course acquainted with the theory of so-called mind-reading put forward by Dr. G. M. Beard, in our number for July last.* It will be remembered that this investigator refers the phenomena produced to a power of detecting and interpreting involuntary and unconscious muscular movements, and declares that "mind-readers are only able to find *direction* and *locality*, and in order to find even these they must be in physical connection with the subject, who must *move* his body or some portion of it. . . . Mind-readers never tell what an object is, nor can they describe its colour or appearance." We may add that in most cases Mr. Irving Bishop is not content to lead the subject about, but drags him or her in a somewhat tumultuous manner. This seems to speak in favour of Dr. Beard's theory, as if during violent motion unconscious muscular action on the part of the subject were more likely to be produced and recognised.

By way of throwing further light upon this theory we reproduce the following letter, which has been forwarded to us by the writer. We may remark that Mr. Edmonds, as a graduate of London University and as the head-master of the Brighton School of Science and Art, may be accepted as a qualified and trustworthy observer, not likely to be himself deceived or to attempt any imposition upon the public. He writes:—

* Journal of Science, Third Series, iii., p. 407.

"To the Editor of the 'Sussex Daily News.'

"SIR,

"With reference to the correspondence which has been going on in your columns relative to 'thought-reading,' may I be allowed in a few words to state my experience? Having seen and heard Mr. Bishop during his first visit to Brighton I determined to try the question for myself. Being in London soon after, and mentioning to the friends with whom I was staying what I had witnessed, it was proposed that we should attempt the experiment. Accordingly I was blindfolded and left the room. Whilst I was absent a reel of black cotton was secreted in a flower-pot near the window. On pressing the hand of the gentleman who had secreted it against my forehead, and requesting him to think of the object he had hidden, I saw plainly with my blindfolded eyes, as though in a dream, the figure of a reel of black cotton floating before me. I then told him to think of where he had hidden it, and I saw and led him to a bureau at the opposite end of the room to the window. This he said was wrong, but on enquiry I found that he had originally intended to have placed it there, but had altered his mind. Does not this, then, seem to point to the same thing that Mr. Bishop spoke of last Wednesday—of unconscious thoughts passing through the mind? In the next experiment a china plate was placed on the table. When I was brought in I saw it vividly, and led up to it, laying my hands over it, and I described it as a round mat, thicker at the edges than within, and with a dark rim, which was just the description of the plate, which plate, by-the-bye, I had never seen before. We then tried the question of localising a pain. Being blindfolded, and holding my friend's left hand against my forehead, I told him to imagine a pain. Almost immediately I felt a peculiar, indescribable sensation on the right side of my face, and told him that he was thinking of a pain there. He was, in fact, imagining a violent attack of neuralgia in the right upper jaw. Other experiments were tried, and have been tried since, some successful, some unsuccessful; but I have seen quite enough to convince me that there is truth in it. I don't pretend to offer a reason, but I would say to those who disbelieve it—'try for yourselves.' All do not possess the power. I was the only one of a party of six or seven who was thus affected, but, doubtless, there are very many who could perform precisely the

same experiments that Mr. Bishop showed, and by continued enquiry it may be that the mystery will be solved.

"I am, yours, &c.,

"HENRY EDMONDS, B.Sc. (London)."

We see that in these experiments physical connection was found needful. No one has, it would appear, in experiments of this class, ever professed to read the thoughts of another without direct or indirect bodily contact. Where there is no connection at all, or where operator and subject are linked together by an inroganic medium, as, *e.g.*, by a wire, the conditions of success are wanting.

Mr. Edmonds, however, seems to have gone a stage beyond what Dr. Beard pronounces possible: he distinguishes colour. This one fact seems to us fatal to the theory of unconscious muscular action. We may very easily comprehend that the arm of the subject, especially if he is in a state of nervous excitement,—as will often be the case in such performances,—may give certain indications capable of serving as a clue to the direction and the locality of the hidden object, and even to pick it out from a number of other articles; but we think it impossible that any muscular action of the subject's arm could suggest to Mr. Edmonds the notion of a cotton-reel at all, and still more of a black rather than of a grey, a white, or a blue reel. It is important to know whether Mr. Edmonds at once, at this stage of the proceedings, announced the nature and colour of the article which had been hidden. The experiment with the plate, where the dark colour of the rim was recognised, tells equally against the "muscle" theory. It would seem, therefore, that there are persons who, when placed in actual bodily contact with others, can, to a certain limited extent, perceive what is passing in the mind of the latter. Nor is this power confined to the case of tangible, material objects, as appears from the experiment of localising a pain.

We quite agree with Mr. Edmonds that further experiment is here urgently needed. Those who possess the power should try if it be possible to recognise in this manner a past experience or a future expectation upon which the subject is concentrating his mind. The question further suggests itself whether any connection between the operator and the subject, save that effected by the living body, will answer the purpose. Dr. Beard's experiments certainly show that a metallic medium like wire is useless, but we do not learn whether he has tried leather, wool, silk, or other lifeless organic matter.

As to the results of such experiments it is utterly idle to speculate prior to the actual trial. But there is one consideration which here suggests itself that is not undeserving of examination. So-called "mind-reading," though publicly exhibited in America by Brown as early as 1875, and though formally described and discussed by Dr. Beard in the "Popular Science Monthly," in February, 1877, has only been recently made known in this country by one who, we understand, assumes the part of an exposer of Spiritualism. We may therefore justly ask in how far will mind-reading, as already known, throw any light upon the so-called "Spiritualistic" manifestations? The preliminary difficulty occurs that mind-reading is itself unexplained in its nature, and that consequently if we use it to explain Spiritualism we are merely putting one unknown quantity for another. But can the passage of thought from one person to another, supposing it fully demonstrated, account for any of the more important of the phenomena upon which Spiritualists build their system? Let us turn to the recent remarkable work entitled "Evenings at Home in Spiritual Séance."* Here the authoress, Miss Houghton, describes the two tests which she accepted as sufficient evidence of the reality of Spiritualism. Miss Houghton, her cousin a Mrs. Pearson, a medium Mrs. Marshall, and the niece of the latter sat together at a round table, and "in a short time the raps came. My youngest sister, Zilla, who died in 1851, was again in conversation with me, and I asked whether anything still troubled her, to which she answered 'Yes,' and on my enquiring what it was, naturally concluding that it would refer to her husband or children, I was surprised by the word 'Helen' being spelt out. Helen was another sister, three years older than herself, who had married a Catholic and had been led away to the same church. This had troubled Zilla on earth, and I felt it was still a grief to her. The name of Helen could never have been the coinage of Mrs. Marshall or her niece, nor was she at all in my thoughts." We must here ask, Was Miss Houghton during this experiment in bodily contact with Mrs. Marshall and her niece? Further, was the thought of her sister Helen unconsciously passing through her mind? If these two questions are answered in the affirmative, it is at least possible that the idea may have passed from the mind of Miss Houghton to that of Mrs. Marshall, and the evidence of the presence of the spirit of Zilla is so far weakened. But in a further

* *See* Journal of Science, Third Series, vol. iii., p. 686.

experiment, where Miss Houghton is implicitly described as not in contact with the medium, whilst a certain date was given by the planchette, no such explanation seems at all admissible. But there are many so-called spiritual manifestations which, whatever may be their source and their nature, are quite incapable of being accounted for by any transmission of thought between the spectators and the medium. Hence we do not see that mind-reading is likely to do any great things towards the "exposure" of Spiritualism. A reflection here occurs to us: why is mind-reading not, like Spiritualism, proclaimed mere jugglery and imposture, or explained by the rather hazy hypothesis of "Dominant Ideas"? Surely the evidence in the one case is as trustworthy as the other, and amongst those who have accepted Spiritualism as truth there are men of attainments as high and of integrity as unspotted as any of the advocates of mind-reading can lay claim to! Why, then, do two novelties, each at variance with commonly received doctrines, meet with treatment so utterly different?

II. HAUNTED HOUSES AND THEIR PHENOMENA: SUBJECTIVE OR OBJECTIVE?

By FRANK FERNSEED.

MANY persons will undoubtedly pronounce this question utterly beneath the level of a scientific journal. Like the negative philosophers of the last century they will adopt the convenient method of banishing to the realm of fable and delusion whatsoever cannot be explained by their system. From this course I must beg to dissent. The more difficult a subject,—the more it has been complicated by superstition and imposture,—the more clearly it is the duty of Science to search closely and perseveringly into its nature. The difficulties here confronting us are not small. We all have a natural tendency—more or less pronounced—to believe whatsoever is mysterious and inexplicable, just in proportion as it departs from the common run of our experience. The "*credo quia impossibile est*" of Sir Thomas

Brown embodies a deep-rooted trait of human nature. On the other hand, there is in us all a vein of scepticism no less unreasoning than the credulity just mentioned. We are loath to accept, or even to sift fairly, a fact which does not chime in with popular ideas. And these two opposite tendencies do not compensate each other. The mind is like a balance where the centre of gravity lies too high above the point of suspension; either scale, if it once gets a trifling impulse, may preponderate.

There is in England, at least, another special difficulty. A haunted house is the property of some one. The more a rumour gets spread that No. 19, Alfred-street, is the scene of unexplained phenomena, the more its value becomes depreciated. If I therefore make observations upon such a house, and publish them, I am in a dilemma. If I give the name of the town and of the street the proprietor may bring an action against me for damages. If I withhold all such particulars the reader cannot test my statements, and is entitled to doubt whether I am not playing upon his credulity.

What is a haunted house? One, simply, where sights are seen, sounds heard, shocks, vibrations, or touches felt, and vague sensations experienced, which cannot be at once accounted for. If such phenomena occur frequently or regularly the house falls into bad repute, the tenants leave, and it remains unoccupied. The cause of the manifestations in question has then to be sought among one out of two groups of agencies:—

a. "Natural." Here we have the deeds and misdeeds of practical jokers, of smugglers, coiners, and other criminals who have got access to vaults and cellars, and whose interest it is to keep the house untenanted. Here also must rank the strange sounds occasioned by rats, cats, insects; by the wind, by unknown water-courses, or by echoes.

b. "Extra- or Super-natural." Under this head would be classed the manifestations, real or supposed, of the spirits of deceased human beings, of other spirits, or of beings of which the "dweller on the threshold" in Earl Lytton's "*Z*anoni" may serve as an illustration. Or, lastly, the phenomena in question may be conceived of as produced by some man who has acquired powers unknown to the bulk of his species, and who exercises them to punish or annoy some enemy.

c. There is yet a third case: the phenomena are subjective rather than objective; illusions rather than facts.

We will address ourselves separately to each of these groups.

The extra-natural agencies will be very readily disposed of by adherents of the monistic system. They contend that as there are no spirits, embodied or disembodied, human, superhuman, or infra-human, the phenomena of haunted houses cannot find here their cause. The conclusion is most just, if only we are certain of the non-existence of spiritual beings. But to enter upon the study of the phenomena of haunted houses with this preconceived assumption is, I submit, illegitimate. *A priori*, we have no more right to proclaim the non-existence of spiritual beings than their existence. We must let ourselves be guided and governed by facts observed. But this reservation having been made, there are very grave objections to the spiritual theory of haunted houses. Foremost comes their comparative rarity. If we consider the multitude of persons hourly passing away, and leaving generally behind them both friends and enemies,—if we reflect that in a very large proportion of houses crimes, or at least evil deeds, have been planned or perpetrated, we might expect that "haunting," if due to the return of spirits from the invisible world, would be the rule rather than the exception.

We are told that the scene of a murder is haunted sometimes by the shade of the assassin and sometimes by that of his victim. It is probable that every house in long-inhabited countries stands on or near the scene of some deed of violence committed within the past two or three thousand years. But scarce one family in ten thousand find their peace disturbed by any occurrence of the ghostly class.

Another point is that the number of haunted houses, small as it is, seems to be on the decrease. I know a district, situate to the east and south of Manchester, where, according to the traditions of the past generation, farm-houses, lanes, bridges, and valleys had not unfrequently their mysterious shadowy occupants or visitants. But now the population of that part of the country has risen to perhaps fivefold what it was at the beginning of the century, cases of haunting, instead of having increased in like proportion, have died out altogether. Ghosts and goblins evidently prefer the country to the town.

A curious fact is that Lancashire was, a century ago, exceptionally the home of the supernatural as compared with

other districts of England, or—if we except Thessaly, the Harz mountains, and Bretagne—of all Europe.

All these circumstances are, I submit, hard to reconcile with the theory which regards haunting as an objective phenomenon due to the agency of spirits. We may, indeed, be told by a certain school of modern thinkers that we are ignorant of the laws of the spirit-world, and that the points which have just been raised might be capable of a satisfactory explanation. A spirit may indeed be desirous of communicating with the living, but the especial conditions under which alone such intercourse is possible may be wanting. Admitting this plea, the most that can be claimed of us is suspension of judgment, and the readiness to decide any case brought forward upon its own evidence.

Far more perplexing than spirits are the semi-material beings of Earl Lytton, and, if I do not misapprehend them, of the authors of the "Unseen Universe." It is all very well to tell us that as the dry land, the seas, and the air have each their occupants, the depths of space and the interatomic intervals may in like manner be inhabited. I reply that all the organisms of which experience tells us are partially at least composed of solid matter, and I confess my utter inability to conceive of portions of liquids or gases being individualised and organised. And if matter exists—as I am not prepared to deny—in any more sublimated state the difficulty becomes greater. I will admit the existence of such beings when I either see them or meet with phenomena from which they may be legitimately inferred.

That strange sights and sounds, as in the case of the "drummer of Tedworth," may be due to the revenge of a necromancer, or, if the term be preferred, of an "occult philosopher," I neither admit nor deny.

We come now to the "natural" agencies by which the inmates of a house may be scared till the cause is discovered. No one can deny that, in numbers of instances, very alarming and apparently inexplicable manifestations have been traced to sources of the most matter-of-fact and every-day kind. To the question, why are haunted houses less frequent in the nineteenth than in the eighteenth or the seventeenth century? the most obvious answer is, because of the greater simplicity and uniformity of modern architecture. The favourite arena for supposed supernatural manifestations was in old castles, monasteries, colleges, baronial halls, not so much because of the deeds of darkness there transacted as on account of their narrow, dark, and winding passages, their staircases concealed in the thickness of the

wall, their trap-doors, sliding panels, and other similar devices. Anyone who examines such a building, or even a farm-house of any pretension built in the time of Queen Elizabeth, or in the days of the Stuarts, will be at no loss to understand why it should be haunted rather than one of our well-lighted modern houses, free from all lurking-places and complexities.

Who ever heard of the cottage of a farm-labourer being haunted, save perhaps by typhoid fever? There is not the space that ghosts love; there are none of the closets from which they emerge, or the pillars and projections behind which they may disappear. We can see no reason why the manifestations of truly spiritual beings should be prevented or made more rare by these changes in the style of building. An immaterial being could, so far as we are able to judge, enter a room quite as easily through the solid wall as through a secret door or a disused chimney, and could disappear as readily through the middle of the floor as behind a statue or a column. But we can well understand the facilities which mansions of the mediæval type must give for the transmission of sounds and for the performances of tricksters and criminals.

Even the question why ghosts should chiefly reveal themselves to the sight or hearing of the living at the "witching hour of night," or—to translate the case into the language of men of the world—why strange sights and sounds are most common about midnight, will probably admit of a very natural solution. I have often, when pursuing some train of research to a late hour, been struck with the creaking of wooden articles, chairs, book-shelves, tables, &c. Heaps of papers which have been left in a state of imperfect equilibrium, but have remained untouched for hours, have sometimes suddenly slipped to the ground. I may be told that in the silence of midnight slight noises attract notice which might escape attention amidst the bustle of the day. I reply that in London midnight is a much less silent time than (say) from 3 to 4 a.m. Further, persons on night-duty in mines, where there is no more noise at one part of the twenty-four hours than at another, maintain that the approach of midnight is marked by a general ticking and crackling in all directions, and that loose portions of rock apparently select that time for falling in preference to others.

But a number of considerations lead us to the conclusion that in a great proportion—probably a majority—of instances the phenomena of haunted houses are subjective in their

nature, and are due to some illusion on the part of the observer. The facts already adverted to—that haunting decreases with the improvement of domestic architecture, with the increase of population and of intelligence, with better lighting in-doors and out, with the construction of broad open roads not overhung by high hedges and trees; the no less decisive fact that whilst large edifices, public and private, are often haunted, cottages and huts never are—all point in the same direction, viz., to imperfect observation on the part of the witnesses.

We see something in dim light. Then, if our fancy or our fears have been excited by loneliness, by the size, the antiquity, or the traditions of the place where we happen to be, we add, without the least intent to deceive, strange details to the image impressed upon our retina.

Illusions similar to those experienced by Nicolai, and due not to any outward object, but to a morbid condition of the brain, are perhaps more common than is suspected. As far as I am aware no one, on seeing a supposed ghost, has ever applied to it the ingenious test suggested by the late Sir D. Brewster. He pointed out that if we press the eye-ball slightly with the finger any real object placed before us will appear double, whilst any phantom having no substantive existence will remain single.

That by far the greater number of supposed cases of haunted houses, or rather the phenomena on the faith of which such houses are pronounced haunted, must be regarded as subjective is certain; that in a very large portion of the remainder the occurrences on record may be traced to natural intelligible causes is equally decided; but there is a balance upon which it is unphilosophical to pronounce. Let us remember that if an avowed juggler reproduces before our eyes some surprising phenomenon which we have witnessed, this is no proof that the original phenomenon was due to jugglery. A skilful mechanician may make an automaton eagle, duck, or fly. Is this evidence that eagles, ducks, and flies are automata? An adroit coiner may palm upon you a piece of base metal as current coin of the realm. Do you, on discovering the cheat, pronounce all gold spurious?

I may mention an instance of a haunted house related to me by a scientific friend, a gentleman chiefly engaged with the study of physics and chemistry, and very far from credulous. When a youth his family resided for some time in Bretagne, and had taken on lease a house at somelittle distance from a small town. Like many French country seats this house faced on one side—the south in this case—on a

garden, whilst the north side looked into a court surrounded by a high wall. In the north-eastern corner was an outhouse, accessible only from the court. My friend, who was then in his 15th or 16th year, occupied a bed-room at the eastern end of the house, looking down into the court. Very frequently before falling asleep he used to see a light passing along the wall of his chamber, but always in one constant direction, as if a person carrying a lantern had left the house by the back door and walked across the court towards the outhouse. Other persons occasionally observed the light from other windows of the mansion, but as if coming in the same direction. My friend, feeling his curiosity much excited, one evening drew his bed close up to the window, so that by merely raising his head a little he could see if there was a lantern being carried in the court. At the usual hour the reflection appeared on his chamber-wall, and when it had passed through about half its course he cautiously peeped out. The court was dark, and the light instantly disappeared from the wall. Much careful examination failed to explain the mystery. The walls and gate of the court were high, and there was not in that direction any house, steeple, or tree overlooking the premises. Moreover, the light always appeared to travel along the upper part of the chamber walls, as if thrown upwards from below. No depredations were ever committed in the house, court, outhouses, or garden.

Several other phenomena of a strange character were observed by my friend and his family during their residence in the house in question, but none at once so easy to describe and so difficult to account for.

We may, I submit, in this case, very fairly pronounce the occurrence as distinctly objective in its character. We may also dismiss the suppositions of trickery, crime, the actions of animals, &c.; but the recourse to the supernatural helps us not the least. We can scarcely suppose a spirit, a "dweller on the threshold," or the like, occupying itself night after night with causing the reflection of a light to travel along the walls of a bed-room!

It is much to be regretted that scientific men are so generally deterred by public ridicule from investigating such phenomena.

III. THE PRINCIPLES OF MAGNETISM.

By CHARLES MORRIS.

(Concluded from page 31.)

IN this progress southward from the north pole it could not matter at what point we took the testing magnet beneath the surface, so that a sufficient distance southward was attained. A line of small magnets starting from the pole, proceeding southward over the surface to some point north of the equator, then curving inwards to the axis, and following this to the point of starting, must display a gradual variation in axial direction, until a complete revolution upon the axial plane is effected. And in all such lines possible to form the same result must appear. If this be the case, then the earth, in its northern hemisphere, must form a magnetic vortex, of closed curves of the kind above indicated. These curves would become less in diameter as they were drawn in the interior, and become very small when confined to the region serving as the centre of their curvation. In the southern hemisphere a like magnetic vortex must exist, with the difference that its curves are opposite in direction to those of the northern vortex. These two vortices are separated by the equatorial plane, into which the curves do not enter, but where the magnetic reversion takes place by a gradual weakening and dying out of magnetic energy in the intermediate zone.

Each of these vortices must have its central zone of rotation, to which the north poles of all magnets display a tendency to point in the northern hemisphere, and the south poles in the southern. These central zones must lie between surface and axis, and between equator and pole, and their locality may be indicated by the surface localities at which the magnetic needle stands vertical to the axis, and thus, perhaps, points directly inwards to these interior zones of vortical rotation. If the magnet, in its southward movement, be carried inward at a point north of this locality, its dipping process could not continue, but must be exchanged for the opposite reversion, since it would meet the opposed curve of the vortex. Also if carried south of the equator the same opposition would result. But between the locality indicated and the equator the curvation would regularly

continue, except in the neutral equatorial plane which separates the two vortices.

These ideas, differing widely as they do from those usually entertained in regard to terrestrial magnetism, in reality need but one admission for their establishment. Admit that the magnetic needle is really part of the earth, and its magnetism part of the earth's magnetism, and all the conclusions here reached seem to necessarily follow. Its changes in axial position indicate like changes taking place in the earth's magnetism, and could only occur under the astatic influence, as here considered. And, as the single energy of gravitation yields a single centre of attraction, so the dual energy of magnetism must yield two centres of attraction, which all may judge, both from the behaviour of the magnet and from the necessary results of astatic action, to occupy the positions above deduced.

The views of magnetic distribution, as here applied to the earth, must equally apply to all minor magnetic masses. And there is much reason to believe that they do so apply. If we take a large magnet, and place near it a minute testing needle, we discover phenomena similar to those displayed by the earth. At the equator the testing steel sets itself parallel to the magnet. Moving towards either pole it displays the magnetic dip, and, at a certain point between the equator and the pole, it stands perpendicular to the axis. Carried still forward the dip increases, until, at the immediate pole, a half revolution has taken place, and the needle has become directly parallel to the axis of the large magnet, instead of reversely parallel, as when at the equator. These phenomena are not so distinctly declared in ordinary magnets as in the earth, on account of their difference in shape. Magnets are usually elongated, slender masses, and the point where the testing needle stands vertical is nearer the pole the more long and slender they become. When thick and short this point moves towards the equator, until it often assumes a position at one-third of the distance from the pole to the equator. Probably, if the magnet were spherical instead of cylindrical, this vertical point would assume a position similar to that it has in the earth—nearly midway between pole and equator.

It is not necessary that the testing needle be magnetised. Induced magnetism will cause it to go through the same series of evolutions. But does not this lead us to a new conception of the state of affairs existing within a magnet? Magnetism, as we have already considered, does not belong to the mass as a whole, but to its molecules as individuals.

These molecules are really independent bodies, and must exert inductive influence upon each other without regard to the fact that they are combined into the same general mass. A magnet, in fact, is a mass of minute magnets, and in no respect differs in character from the earth as a mass of larger magnets. These molecular magnets seek to force each other into astatic relations; but the local action in a regular mass of magnets of equal energy must be even less efficacious than in the irregularly magnetic earth. The action of induction must become general instead of local with the result that the molecules of the axial and surface regions must set themselves reversely parallel to each other. And the small testing magnet must become, virtually, a molecule of the large magnet, and assume, at every position, the same direction possessed by the molecules at that position. For such a small magnet could no more set itself up as an independent body than could a molecule of the larger mass or a magnetic needle as applied to the earth.

The dip of the small magnet, then, indicates a like dip of the surface molecules. At the point where the small magnet stands perpendicular to the axis the surface molecules must do the same. Beyond this point the continued reversal of the small magnet indicates a continued reversal of the surface molecules. The complete reversal of the small magnet at the pole indicates a like reversal of the surface molecules. Thus the evolutions of the small magnet must indicate a like series of evolutions performed by the surface molecules of the large magnet. These, at the equator, are reversely parallel to the axis; at the pole they are directly parallel to the axis; and at every intermediate point they are intermediate to these two positions.

But this similarity of every magnet to the earth leads us to apply the same deduction to both cases. An interior dip like that we have supposed to exist in the earth must likewise exist in every magnet in which it is not counterbalanced by terrestrial influence. Thus each magnet must virtually comprise two magnetic vortices, whose centres of rotation lie beneath the point of vertical dip, while their superficial curves are separated by a neutral equatorial region. And these two vortices are comprised within a single vortex, which is indicated by the fixed direction of the magnetism of the axis and its complete reversion in the surface of the mass.

This general vortex we can see, by the aid of iron filings, extending itself in significant lines from the equator to the poles of the magnet. The iron filings virtually become fluid

exterior molecules of the magnet, and reveal the conditions existing in its interior. Over the equator they extend in lines parallel to the axis. Farther north or south they dip, and eventually become vertical to the axis. This dip increases, until at the poles they stand reversely parallel to their former direction, and in the line of the axis. Throughout the axis this reverse parallelism doubtless continues.

If the magnet be touched to the iron filings these attach themselves strongly to the poles, and weaken in their attachment as they approach the equator, where they fail to attach themselves. From this it is argued that magnetism is strongest at the poles and weakest at the equator; but such a conclusion does not necessarily follow. At the equator the axes of the molecules are directed parallelly to the axis of the magnet. Thus their energy is not exerted outwardly. And as the magnetism of the surface molecules is similar in direction to that induced in the filings, they must repel instead of attracting these. Leaving the equator the dip begins. One pole of the molecule is directed outwardly, and an attractive influence is exerted. This increases steadily towards the poles, at which one pole of the molecule is turned directly outwards. The fact that the molecules and filings are similar in axial direction, which would cause repulsion were they side by side, causes attraction when they are end to end.

We have argued, from the admitted premises, that the magnetism of masses is a combined result of the magnetisms of their constituent molecules. We may now ask, What is the magnetism of a molecule? And in this question a second is involved—What is a molecule? To give the latter its general expression we say—A molecule is an aggregation of atoms. And we shall probably have to seek in these atoms the true origin of the phenomena of magnetism, and the cause of its many variations in strength and character. According to the theories of Ampère and Weber magnetism arises from the flow of constant electric currents around the surface of molecules. The Ampèrian theory is constantly and gravely repeated in text-books, to the present day, without a hint being given of the indisputable fact that it is quite at variance with the principles of energy, as now understood. It is easy to imagine a constant current of electricity, and make it answer a definite purpose, but the truth is that no such thing exists as a constant current of electricity, in the Ampèrian sense.

The current of static electricity is instantaneous. It ceases as soon as the electric equilibrium has been restored.

The current of galvanic electricity consists of a series of instantaneous currents, and ceases when chemical equilibrium is restored. The current of thermo-electricity is likewise composed of instantaneous components, and ceases when temperature equilibrium is restored. Thus electric currents are a consequence of the effort to produce equilibrium of forces, or of heterogeneous motive conditions to become homogeneous, and can only continue while this restoration of equilibrium is in process of being produced. If there were disturbances of equilibrium of force in molecules, they could produce no effect while the disturbed condition continued unchanged. Only while equilibrium was being restored could electric currents arise, and they must cease when this process was completed. Such an action would probably be instantaneous. It is impossible to conceive of any point of a molecule being constantly overheated, or in an unceasing state of chemical change, in spite of the constant effort to restore its force equilibrium. Therefore it is impossible to yield assent to the Ampèrian hypothesis of magnetism.

In fact the constancy and the peculiar relations of magnetic energy can be understood only under the hypothesis of attraction already advanced by the writer. If attraction be a result of the action of motion upon motion, parallel motions attracting, opposite motions repelling, the whole difficulty vanishes. Let us suppose atoms to consist—as advanced in my last article in this Journal—of minute masses of ether, rapidly rotating, and having the form either of spheres, of circular disks, or of circular rings, according to the relations of vigour between their centrifugal and their centripetal energies. If this motion of rotation exert an attraction upon all similar motions, and a repulsion upon all reverse motions, the atom would act as a magnet, this unceasing motion, with its force relations, answering every requirement of the impossible electric currents of Ampère. Every atom would have two magnetic poles of equal vigour, its axis of rotation forming the magnetic axis, and the two poles of this axis the magnetic poles, each of which would attract the unlike and repel the like poles of every other atom.

If such be the constitution and the magnetic relations of an atom, we may ask, What is the constitution and the magnetic relations of a molecule? Twice already, in this paper, the probable arrangement of a mass of small magnets has been considered. It is not necessary again to repeat it. But a molecule composed of magnetic atoms

would also constitute a mass of small magnets, which must arrange themselves under the same principle displayed by the magnetic molecules of masses, or the magnetic masses of the earth. Nature, in this particular, must repeat herself in the largest and the most minute masses. The mass of atoms must have a magnetic axis, and a magnetic equatorial surface with the poles of its atoms reverse to those of the axis, while all intermediate atoms must assume the necessary intermediate direction. A molecule, therefore, must be a counterpart of a spherical magnet, or of the earth, its magnetism, when undisturbed, exerting itself inwardly, and only displaying itself outwardly under strong exterior magnetic influence. Whatever the arrangement of these magnetic atoms, and the degree to which their dual energy is masked by their interior relations, they must be susceptible to exterior influences, and this magnetism may be usually made to display itself outwardly. If a magnet of sufficient energy be brought near to masses of such molecules, they will, in the majority of cases, display some degree of magnetic force, precisely as two magnets do when brought close together. This magnetism is induced, and usually disappears on removal of the magnet. Nor is its origin difficult to comprehend under our hypothesis. For the magnets in any homogeneous aggregate must, when free from exterior attractions, feel only each other's influence, and so arrange themselves as to exert all their force inwardly. But on the approach of an exterior magnet this arrangement is disturbed. The magnets seek to shift the directions of their axis so that a portion of their polar energy can be exerted in the direction of the external magnet. But this magnetic action must be conveyed from molecule to molecule, and, where these are too far apart to readily act upon each other's magnetism, only a very vigorous external force can produce a general accordance. Where they are close together, or for any other reason easily yield to each other's influence, they must more readily obey the energy of external magnetic attraction, and with the greatest readiness in the line of greatest approximation of molecules. It need scarcely be said here that the facts of magnetism agree with the above deductions, magnetic substances, with few exceptions, being those whose molecules are closest together, while crystals are most strongly magnetic in their axis of greatest density. In certain cases the magnetism thus induced becomes permanent, the molecules as magnets continuing to affect each other magnetically, and their conjoined magnetism displaying itself outwardly. Thus the action of

mass upon mass, in the production of permanent or of temporary magnetism, is the result of the action of molecule upon molecule, they in the one case assuming a permanent, in the other a temporary, magnetic arrangement. It is not improbable that the differences in magnetic energy of different substances arise from two causes only—the original weakness or strength of the magnetism of the atoms, and the degree of contiguity into which they are brought in their compounds. They necessarily act upon each other like separate magnets. If these be close together they control each other's solar direction. Placed at a certain distance apart they fail to control each other's direction. The same rule doubtless holds with atoms and molecules. Thep may. in their incessant motions, frequently come together so close as to mutually control each other, but they must be normally in this intimate relation to yield a permanent mutual control. Thus in one case the atoms of molecules may be so far separated as to feel no permanent mutual influence. In a second case they may permanently act upon each other, and the molecule become magnetic. But again the magnetic molecules of a mass may be so far separated as not to affect each other. In another case they may be close enough together to act upon each other magnetically. But even in this case local action between them seems to hinder general action, and to produce magnetic neutralisation in the mass as a whole. Only when forced into harmony through the energy of a strong exterior magnetism is this local action overcome, and temporary or permanent magnetic relations produced between the molecules as a whole. Astatic relations arise between surface and axis, the equatorial diameter decreases through their mutual attraction, and the polar diameter increases through the pressure exerted.

The relation thus produced between the molecules of a permanent magnet is one that is easily disturbed. Heat, by separating the molecules, overcomes it, local action is resumed, and magnetic neutrality results. Tne influence of exterior magnets also disturbs, and often reverses it. Thus general magnetic relations between molecules is not a normal condition of masses, since it never arises of itself, but always through external influence.

It may be that the diverse magnetic behaviour of different substances is a consequence of the above relations of their molecules. All substances whose molecules are susceptible of assuming harmonious magnetic relations may be magnetic; all whose molecules resist being brought into harmonious magnetic relations may be diamagnetic. For a

substance to be magnetic all its molecules must respond to external magnetic attraction, and shift the directions of their poles in accordance therewith. But it may be possible for the molecules to be so related to each other individually that a general conformity of direction is vigorously opposed by those local relations of harmony. As two or more magnets brought together upon the earth's surface affect each other so strongly as to overcome the energy of terrestrial magnetism, and enter into local relations of astatic or general harmony, so it may be with molecules. They may be so combined as to form local groups, in which a certain astatic neutralisation takes place, and thus relieves them from the influence of other, similarly neutralised, groups.

In such a case the molecules would probably resist the influence of a powerful exterior magnetism. It is a question of the balance of vigour between the local relations of the molecules and the vigour of the exterior magnet. In some cases the local relations may be overcome, and a general relation produced, either permanent or temporary. In other cases this general relation may be vigorously resisted, the local action of the molecules displaying the same resistance as the local action of magnets does to terrestrial magnetic energy. In the latter case the phenomena of diamagnetism must appear.

For if the molecules refuse to shift the directions of their axes in response to external magnetic energy, they must in some other manner respond to this energy. The positions of some of them must be such as to render them less resisting than others. In the case of certain crystals, for instance, the resistance is less effective in one crystalline axis than in the others, and the crystal sets axially in this direction. But if there be no such special axis the effect of resistance to magnetic leverage must tend to force the resisting molecules out of the line of magnetic force, until the smallest possible member remained in this line. The mass sets eqcatorially to the magnetic axis.

There is here no repulsion. The effect is in direct response to magnetic traction. It is the result of a strain between external and internal forces. Where the molecules yield individually to the external energy, and shift their polar directions into conformity therewith, the mass must set axially. Where their mutual influences enable them to resist this individual action, the same influence causes them to move bodily, and in such directions as to reduce the conflict between external and internal energies to the smallest sum. The mass sets equatorially. If this be the case, then

alike in magnetic and in diamagnetic phenomena the attractive influence of magnetic energy is alone concerned. But in the former case the action of the external is sufficient to overcome the resistance of internal energies. In the latter case it is insufficient, and the traction acts in such a way as to reduce the conflict of forces to the lowest possible level.

IV. BEAUTY IN THE EYES OF AN EVOLUTIONIST.

By F. Ram.

AMONGST the new departures in Philosophy consequent on the discovery, by Mr. Darwin, of the way in which Evolution was effected by means of Natural Selection, it seems inevitable that some change in the older prevalent ideas connected with æsthetics must eventually be included.

Although most persons assume that Beauty, where it exists, is immanent, and is the same *semper et ubique*, difference of opinion on any point being attributed to more or less good taste, such an assumption has not been left undisturbed in the minds of men of a speculative disposition, by whom the question whether Beauty is an absolute quality, or one relative to certain conditions, has been discussed at least since the time when philosophy flourished in Greece. The conclusions arrived at by the best-known writers on the subject are found, however, on examination, to be very conflicting; and I believe that it may safely be said that no satisfactory result has been arrived at by them. One prominent theory is that Beauty resides in "fitness,"—that is, the fitness of the admired object to its place in Nature. This theory, taken as a universal truth, appears to me to be quite untenable, for it implies that we can see no beauty in any object until we have acquired so much knowledge respecting it, and its surroundings, that its fitness is evident to our understanding; which presupposes either an altogether incredible amount of knowledge and capacity of

discernment in the mind of the admiring spectator, or else that he is indifferent to the appearance of most of the objects that present themselves to his sight. Nevertheless I think that it may be shown, to all those who believe in Evolution and in Sexual Selection, that the "fitness" theory is true as regards all those beauties which in either sex most impress the minds of the other sex, such beauties being the outward visible signs of certain qualities of body and mind which make an individual to be one of the fittest to survive in its environment.

From the Darwinian theory, that the struggle for existence results in the survival of the "fittest," it appears to follow also that the number of descendants springing from those who, through their superior fitness, survive, must be greater than the number of those deriving descent from the less fit, and also—and this is the fact upon which, I think, that a sound theory may be built—that wherever Sexual Selection prevails (that is to say, wherever either sex can exercise choice in mating) those whose æsthetic taste delights most in the outward indications of the possession, by the other sex, of qualities which go to make up the "fittest," will have more descendants than those whose fancy is better pleased with indications of the possession of qualities which make a person *less* fit. And thus, since the taste will in either case be inherited, there will be a general tendency, generation after generation, to bring the æsthetic taste of a community into strict harmony with the characters of body and mind most proper to the environment.

The environment to which any type of beauty is thus correlative will not of *necessity* be that in which a race is living. It must be that in which its ancestry lived in the past time, during which the taste was being formed; but there will not be this discordance where the whole community has lived in the same environment for many generations. In other circumstances, such as the change of environment caused by permanent migrations, a corresponding change of taste must be in process.

It is well known that the different races of mankind do not agree in their ideas of Beauty. This fact is readily explicable on the supposition that the various environments are the foundations on which the various tastes are built. For those who love to see in the opposite sex those outward indications of the possession of characters which have little value in the struggle for existence, and *mate accordingly*, will have *fewer* descendants than those who fall in love with the visible signs of the possession of such qualities as are pre-eminently useful in the environment.

XUM

That this theory must be true as regards every important point can hardly, I think, be doubted by anyone who believes in Evolution by Natural and Sexual Selection. For, supposing that there were any such thing existing as perfect unconditioned self-beauty, the human mind would surely be unable to detect it, unless such beauty is in correlation to the human qualities adapted to the surroundings. Let us take bodily proportion as an illustration of this fact. Say that in man the proportion of stature to chest measurement should be as 7 to 4, and that an artist with a perfect eye for beauty would admire these and dislike other proportions. If they are not also the proportions most likely to lead to success in the struggle for existence, it follows that those individuals who admire the proportions that are so, and *mate accordingly*, will leave more descendants, *inheriting their taste*, than those who have a better artistic eye, and mate accordingly. In the end these latter strains with the correct taste will dwindle in number, generation after generation, down to extinction ; for they will not be able to contend with those who have the taste which is bad in an æsthetic point of view, but good in the purely material one.

I believe therefore that—at least as regards all those principal points of beauty in a human being which most attract the attention of the opposite sex, and the charms of which most engage the pen and pencil of artist and poet—a general *Law of Beauty* may be stated thus :—

> *The visible signs of the possession of those qualities of body and mind which have tended in the environment of a race to the production of the largest number of descendants constitute Beauty among that race.*

So that in an unaltered environment it might safely be affirmed of one hundred persons, of whom it could be foretold that they would have one million descendants after a given lapse of time, that they have a higher average of beauty (in the eyes of the same race) than one hundred other persons who would have one thousand descendants only within the same time ; and that the latter are more beautiful than those from whom eventually few or none will derive descent. This law is limited to the beauty of humanity, as perceived by each race, and to the beauty (in the eye of its own species or variety) of such animals as have had Sexual Selection working amongst them.

If there had never been any Sexual Selection, but men and women had always been joined together on some other system,—say, in order of birth,—the theory would have had

no foundation whatever. And indeed in that case there would have been no Beauty,—that is to say, none of those aspects which now in either sex principally attract and delight the eye of the other sex would have been gazed upon with any special admiration.

It must be remembered that man is *practically* a machine, and that his beautiful body is adapted to a work-a-day world. To hear most people talk on the subject, one might suppose that the "human face divine" was made up of "flesh" placed on the bones for the purpose of making up a countenance, whereas it is really composed of muscles which are required to move the jaws. Again, as regards the proportionate dimensions of the body: man's heart and lungs fill his chest, and they and his whole respiratory system must be adapted to the composition of the air which he breathes. In the atmosphere the oxygen is in the proportion of 1 to 4 of its ally, the nitrogen. But if the mixture of these two gases had been different; had the oxygen, say, been equal in quantity to the nitrogen, or had been 1 to 40, or 400, the measurements of man's body must have been altogether different from what they now are. And therefore those who, when gazing on a fine statue, can believe in an intrinsic self-beauty, seem to be driven to a conclusion which jars very much with the widened conceptions of the universe existing at the present day, namely, that the ingredients of the atmosphere were mixed in proportions specially adapted to produce beautifully shaped men and women. And not only so; but even the very mass of the earth itself must also have been regulated on the same grounds; for the density of the air on the earth's surface, and the quantity of oxygen inhaled at each inspiration, must depend on the weight of our planet. So that if Tellus had only been, say, of the same mass as the moon, man's shape must have been quite different from that which we now consider beautiful.

If we now direct out attention to other aspects of the human body, the theory advocated will be seen to be supported by the evidence to be drawn therefrom. The *vera causa* of deep æsthetic emotion is seen as clearly in *Complexion* as in anything. For it will be allowed that a good colour is a sign of health. Now health being an advantage in the struggle for existence, it follows that the possession of it tends, on the one hand, to increase the number of one's descendants, and, on the other, admiration of a visible sign of its existence in the other sex tends to give a numerous progeny to those who have this inheritable taste in force. The "association school" of writers on the subject of Beauty

would doubtless say that a rosy complexion charms, because we learn to associate health with it in our minds. But I think it vastly more probable that the love of a fine complexion is purely *instinctive*, and that we should equally think it beautiful if we had been taught that it was a sign, not of good, but of ill health. In fact, those who in past generations had a good eye for the right tint have left many descendants (inheriting the taste), and those who were indifferent to it fewer, if any.

The physiological reason why the beautiful rosy or pink complexion is admired is this:—The red corpuscles of the arterial blood give the colour; and it is they which carry the indispensable oxygen through the arteries to the parts of the body requiring it, so that the good complexion witnesses to the goodness of the respiratory system. If the blood were colourless, and the cheeks were reddened by an effusion of a vermilion liquor, gushing from special glands, and serving no other purpose than that of embellishing the countenance, the argument would of course fall to the ground. But inasmuch as the colour is evidence that the system is well furnished with that gas upon the ceaseless supply of which all bodily and mental activity—life itself—immediately depends from moment to moment, it appears clear that the physical fact creates the beauty.

It is to be noted that Natural Selection has given to woman an uncontrollable knack of showing her blood as much as possible when a *favoured* admirer stands before her, her blushes saying—"See, here is oxygen-laden blood. Do you see these red corpuscles? What a respiratory system your sons by me would inherit!" It is not without significance, too, that this blushing, though involuntary, is (as the Commander of the Faithful is told by his wife in one of the "Arabian Nights Tales") a proof that she loves her male admirer. The red corpuscles are made to attract his attention in proportion to the degree in which the match is *instinctively* seen by her to be desirable, with reference to the viability of her offspring. The blush is the more advantageous from the fact that moonlight is proper to courting—a light in which the cheeks look more pallid than in the light of day.

The much-admired "vermeil-tinctured lip" and "bright eyes" tell of the same desirable physical quality, namely a good circulation of healthy blood.

If space permitted it might be shown that there is a general correlation between the attractions of either sex, and such good physical qualities as would tend, through the

æsthetic taste leading to the increased chances of viability in the offspring of persons who have such taste, to the multiplication of descendants. But an allusion only to some of them will perhaps be sufficient to maintain our case. Thus there is evidently a connection between the beauty of an unbroken row of sound white teeth and the use for which they have been required. If our race had always fed themselves by a process of suction instead of by biting there would have been no beauty seen by us in the finest row of teeth—an altogether different feature being the delight of our eyes.

The beauty of a good head of *hair* is connected with the protection it affords. It is true that the head may be covered by some artificial head-dress; but an irremovable covering would be a greater security against strokes of the sun, which may be suddenly fatal without any preliminary warning discomfort, as well as against the atmospheric changes so apt to produce colds. The human back has indeed been deprived of its hirsute covering, but the dangers arising from this loss may have been of less consideration than the advantages thereby gained. The loss was really a gain, as the artificial protection would more than make good the natural one, since it could be more readily cleared of *Epizoa*, and could be shifted when too heavy for the season or sodden with wet.

(To be continued.)

V. SILKS AND SILKWORMS.*

By J. W. Slater.

FOR ages the silk of commerce has been furnished by one silkworm, the larva of *Bombyx mori*. Such is at least the general opinion, though in strictness it must be admitted that five other species of *Bombyx*, all, like the first mentioned, feeding upon the mulberry, exist in a state

* Handbook of the Collection illustrative of the Wild Silks of India in the Indian Section of the South Kensington Museum. By Thomas Wardle. London: Her Majesty's Stationery Office.

of domestication in China, Bengal, and Burmah, and that their silk is not unknown in trade. These are *Bombyx textor*, *B. sinensis*, *B. cræsi*, *B. fortunatus*, and *B. Arracanensis*. It is, however, a great mistake to imagine that the power of producing silk in commercial quantities and of useful quality is limited to these six species. Two entire families of moths, the Bombycidæ and the Saturniidæ, secrete silk to a much larger extent than do other insects, and amongst these no fewer than fifty-seven species have been more or less closely studied by Mr. Wardle with a view to their utilisation. The produce of these species is known as wild silk, inasmuch as the insects are not systematically bred in a state of domestication, and fed upon cut leaves supplied to them regularly, but are chiefly collected in the forests. Hence the supply is necessarily limited and fluctuating, and the part which these silks are capable of playing in the arts has not been till lately worthily appreciated.

It may be asked, What necessity is there for promoting the culture of these silks, and for introducing them into commerce? To this question there are three sound answers. As the products in question will be, if developed, a source of remunerative employment to the people of India, it is a matter both of policy and of duty to turn them to the best possible account. Again, these silks possess properties in some respects different from those of common silk, so that they suggest novel applications in the decorative arts. Lastly, the supply of silk at present is quite unequal to the demand. Hence has arisen that disgraceful fraud known as "weighting" or "loading." Silks in these days are not dyed for the legitimate purpose of giving them some desired colour, but, especially in the case of black goods, of increasing their weight. The manufacturer when he sends, say, 100 lbs. of silk to be dyed, stipulates that he shall receive back sometimes as much as 300 lbs., the difference being made up by the vegetable and mineral matter deposited upon the fibre. This procedure has become so general that its immoral character is entirely overlooked, and it may perhaps excite the anger of the reader if I pronounce it—as I am bound to do—fully on a level with forgery and coining. In justification of this view I must point out that the value of silk is based upon certain physical and chemical properties which it naturally possesses. It is a very poor conductor of heat and of electricity; it bears a great strain in proportion to its thickness, and by reason of its smoothness it is less affected by friction than are other textile fibres. It is, further, not readily combustible, and may be pronounced

incapable of spontaneous decomposition. Rags of silk buried in the earth, or placed in dung-hills in contact with putrefying matter, animal and vegetable, remain unchanged. It is, further, less easily soiled than linen, cotton, or wool, since dirt does not so readily adhere to its polished surface. In all probability, from the same reason and from the wire-like structure of its fibre, it must be less liable to receive and transmit infectious matter than are other textile materials. All these properties of silk mark it out as peculiarly adapted for human clothing, independent of its lustre and of the beautiful basis which it presents for the finest dyes. But all are sacrificed by the process of weighting. The silks are alternately steeped in decoctions of catechu and logwood, and in solutions of iron—the so-called *rouille* of the Lyon dyers. In addition come solutions of potassium ferrocyanide, for the purpose of depositing a quantity of Prussian blue upon the fibre and counteracting the brownish tint communicated by the other ingredients. At last, after a number of operations, sometimes exceeding twenty, the dyer succeeds in converting the original pound of silk into three pounds of something! That his task is difficult and delicate there is no denying. But so is that of the forger, who, in spite of all the elaborately engraved and coloured grounds till lately in use, succeeds in altering the figures and words expressing the real amount of a cheque, and in substituting others. But our admiration for his skill and knowledge does not blind us to the criminal character of his purpose. We do not see that the "loading" and "weighting" dyer should fare any better, though he is merely the cat's-paw of the manufacturer or the merchant. For what has he effected? He has rendered the permanent, almost incombustible silk not merely inflammable on contact with a match or a lighted candle, but capable of destruction by eremacausis, and even of downright spontaneous combustion, endangering goods trains, ships, and warehouses. Here surely is a laughable instance of human folly. We try, earnestly and perseveringly, to find out some method of rendering cotton and linen tissues uninflammable; but when Nature kindly gives us a material free from this danger, we work in the opposite direction, and do not rest till we have rendered it not merely liable to ignition, but even spontaneously combustible. The very same treatment renders the silk a much better conductor of heat and electricity, reduces its power of supporting a weight or strain, and of resisting friction. Its surface on microscopic examination is no longer smooth and glassy, but rough. Hence it readily takes up dirt, and is

soon damaged by wearing. That the lustre and the beauty of the fibre are sacrificed needs no demonstration.

The plea of cheapness is of the less value because the reduction of price to the consumer is never in proportion to the additional profit of the manufacturer, and still less to the deterioration of the goods themselves. We are sometimes told that the public "will have" weighted silks: this is the usual plea of sophisticators. But as public taste has been artfully corrupted, it would resume a more healthy tone if the fraud were at once sternly suppressed. Meantime the best reply to the weighters and loaders is to produce genuine silk in such quantity as to lessen the temptation to fraud. If this desirable end is gained great credit must accrue to the government of India, and, more than to any other man, to Mr. Wardle.

I will now take leave to make a few remarks on the entomological side of the subject. We cannot fail to notice the existence of two hybrid silkworms which are produced not as physiological rarities, but in quantity, so as to be commercially available. The so-called "Ailanthus silkworm" of Europe is a cross between two species of *Attacus*, the *A. cynthia* of China and the *A. ricini* of Bengal. This hybrid was first experimentally produced in France under the care of M. Guérin-Méneville, and has been successfully introduced into various countries. Again, *Antheræa Yama-mai*, of Japan, has been crossed in France with *Attacus Pernyi* of North China, the hybrid insect being exceedingly hardy. These facts are commended to the notice of such writers as still think it necessary to deny the permanent fecundity of hybrids.

Mr. Wardle, in his work, not merely figures several of the most important species in their successive states as larva, as pupa in the cocoon, and as the mature moth, but he has described and figured the scales from the wings of several species. The value of characters drawn from these scales for the distinction of species, or even genera, is very doubtful. Mr. Wardle's figures all show correctly the insertion of the stem or shaft to the body of the scale as it occurs in all the main groups of the Heterocera; that is, the stem is attached, as is the stalk to (*e.g.*) a laurel-leaf, whilst in the Rhopalocera it is inserted in a kind of notch between two projections. But in other respects the scales are of the less diagnostic value, because in different parts of the wing of one and the same species they vary as much as they do in different species: there is moreover, I believe, in every case a double layer of scales, the upper and the under stratum

differing in form. Lastly, these scales are easily detached, so that if a moth has struggled on being captured, the scales from different parts of its wings become more or less blended, and two observers in taking portions for microscopic examination can rarely hope to obtain quite identical forms. I have compared the author's figures of the scales of *Saturnia carpini*, male and female, as taken from the middle of the anterior margin of the fore wing, with corresponding specimens from my own collection, and whilst I find the general structure of the scales correctly rendered, I fail to recognise the well-marked sexual distinction shown in Mr. Wardle's plates. His remark that there is no relation between the size of the scales and the size of the insect producing them, or the extent of its wings, is perfectly correct. The statement that there is a correspondence between the size of the scales in any species and the thickness of its thread, I have not had an opportunity of verifying, but it deserves attention. Mr. Wardle gives a table of the diameter, strength, and tension of the fibre of several of the most important silks. There is no mention as to any difference in diameter between the thread of the male and the female in any of the species examined. An error is exposed which has found its way into some entomological works. The two threads which issue from the orifices of the silk-glands are sometimes said to be twisted round each other as they issue from the so-called spinnerets. This is a mistake, as on microscopical examination they are found to be simply laid side by side.

A most important point is the colour of the silk produced by each species: that of the common silkworm is generally white, sometimes more or less verging to a yellow. In the other species the silk is of a deeper colour, verging sometimes towards a green and sometimes to a brown. Hence before the silk can be used in the manufactures, except for some especial deep and dark shades, it requires to be bleached. Here, accordingly, was the first obstacle to the utilisation of the wild silks. The produce of the common silkworm is easily bleached, either by the process of "stoving" —*i.e.*, exposure to the fumes of burning sulphur—or by steeping in solutions of the bisulphites of soda or of magnesia, slightly acidulated with hydrochloric or oxalic acid. In both these methods sulphurous acid is the active principle, and destroys the colouring-matter of the silk by depriving it of its oxygen. But this method of bleaching, so satisfactory with the silk of the common mulberry-eating silkworms, fails altogether with the wild silks. The late eminent technical chemist Tessié du Motay, therefore, tried to bleach

them by means of an oxidising agent, and at first made use of permanganate of potash. The brown or orange colouring-matter was thus quickly destroyed, but the fibre of the silk was so much injured as to be unfit for spinning and weaving. He next tried barium peroxide, which in contact with water gradually gives off oxygen and destroys the colour. By this means it has been found possible to bleach the wild silks so that they can be dyed to the palest and most delicate shades. One drawback remains—the expense of the process. The cost of bleaching is 2s. per lb., which is a heavy charge for a material which does not itself cost more than 10s. per lb. Acccordingly experimentalists, and above all Mr. Wardle, are seeking to introduce a process equally effective and more economical. The results already attained are understood to be highly promising, though the details cannot be made public till the process is rendered perfect and has been secured by means of letters patent.

In the meantime Major Coussmaker, a diligent and skilful cultivator of wild silk, is turning his attention to preventing the silk from becoming coloured in the cocoon, so as to do away with the subsequent necessity for bleaching. It is known that the worm or caterpillar hardens its cocoon by means of a certain cement consisting of urate of ammonia, and being, in fact, of an excrementitious nature. Major Coussmaker writes:—"This year, by opening the cocoons at various intervals, I was able to convince myself of the fact that when the caterpillar has left off eating, and begins to spin, it voids the food remaining in the alimentary canal, first of all in a more or less solid form and of a dark colour. but after it has become fully enveloped in the cocoon the excrement comes away as a light coloured liquid, the hue and consistency of which depend upon the amount of vegetable matter not previously evacuated, and the amount of lime, carbon, and ammonia present. The respective proportions of these ingredients vary, I presume, with the food on which the caterpillar has fed, and with the state of the atmosphere at the time of spinning. The longer they remain coating the fibre, the harsher and the more discoloured it will be. It is therefore very necessary, I think, to remove this current at a very early date, and this chemistry has shown the manufacturers how to do. Before long fresh cocoons will be, at an early stage, thoroughly cleansed from all discolouring matter, and the Tasar silk will be available for manufacturing purposes as colourless as when first put forth by the caterpillar." Major Coussmaker has sent Mr. Wardle a cocoon thus purified, and free from all brown or fawn colouration.

Of the wild silks the most important are the Tusser or Tussah,—more properly written Tasar,—the product of *Antheræa mylitta;* the Eria, yielded by *Attacus ricini;* the Moonga, Mooga, or Muga, from *Antheræa Assama;* and the silk of *Attacus Atlas*. This moth is the giant of the silk-producing families, and measures 10 inches across its open wings.

The wild silks, as may be inferred from the difficulty met with in bleaching them, differ in their chemical behaviour from mulberry silk. A cold solution of zinc chloride dissolves common silk in three days, but has no action upon the Tasar even in a fortnight. The affinity of these silks for colouring-matters is feebler than that of common silk; they take up the aniline dyes better than most other colours.

Mr. Wardle has been especially commissioned by the Indian department to ascertain what dye-wares, natives of India, are best suited for use with Tasar silk. He has got exceedingly satisfactory results with lac, safflower, the leaves of *Phyllanthus emblica*, the calyces of *Thespesia populnea*, the flowers of *Butea frondosa*, indigo, hursinghar flowers, and the flowers of *Œdrela toona*. In the second rank he places a number of colours, among which the best known are munjeet (Indian madder), sapan-wood, and the root of *Morinda citrifolia*. Upon Eria silk Mr. Wardle has produced an assortment of shades which leave little or nothing to be desired. The Muga silk is more easily dyed than the Tasar and the Eria, giving better shades at a less cost.

Summing up the progress that has been effected in the utilisation of these silks, it may be said that their bleaching, dyeing, and printing, though still capable of improvement, have passed the stage of experimentation, and fairly entered upon that of industrial practice. The reeling of Tasar cocoons and the carding and spinning of the other silks have been greatly improved, and practical men—little given to fits of enthusiasm—are discovering that these hitherto neglected materials have before them a great future.

The wild silks also admit of applications hitherto novel, and for which our older textile fibres are less suitable. Thus the Japanese combine upon silk tissues printing and embroidery, thus opening up a new style in art manufactures capable of being greatly extended and diversified. Mrs. Wardle has produced some novel and excellent effects in embroidery upon Tasar cloths. I may here suggest that ladies whose native refinement of taste has been scientifically

and artistically cultivated might have a very beneficial influence in the development of the decorative arts.

I cannot help mentioning an unfortunate error, clerical or typographical, in Mr. Wardle's pamphlet. In the scheme showing the position of the silk-moths in the animal kingdom, "arthropoda" has been converted into "anthropoda."

VI. THE "MYSTERY" OF GEOLOGICAL FAULTS.

By Robert Ward.

IN the January number of the "Journal of Science" D. Y. C. says that "Faults are one of the mysteries of Geology," and he asks, "Why are faults so often found V-shaped? How has such a phenomenon occurred?" He further observes that "Faults are not wholly owing to district subsidence, or more remotely to shrinkage. . . . It is demonstrable that faults of the same district are not all of the same period. The new formations are found lying unconformably on older formations, *each* with their separate set of faults. And probably under these again would be other sets. I am strongly inclined, therefore, to believe it to be owing to causes ending finally in local compression, or *yielding* fluctuations of strata—waves, in a rough sense, of semi-fluidified strata."

The mystery will be easily solved if we admit that the Earth is a growing body. Faults take a V-shape when two cracks "hade" into each other in reverse directions, and the V-shaped mass of strata between the cracks is often thrown down as the result of a slow separation of the sides consequent upon the Earth's expansion. For the same reason, whenever the strata on the two sides of an inclined crack are found at different elevations, the inclination (or hade) will always take a direction indicative of a separation of the two sides. Perhaps, in some cases, this may be supposed to be accounted for by elevation alone, but certainly it is best explained on the theory that the Earth is a growing body, and that the crack has widened so as to permit of the strata on one side being "thrown down" as

contrasted with that on the other. Mr. Wallace, in his interesting work on "The Laws which Regulate the Deposition of Lead Ore in Veins," says that in some cases the strata had been subjected to much tension before it was fractured is a conclusion "which hardly admits of a doubt." Referring to this I have elsewhere observed—"It is obvious that expansion from growth would be likely to have such an effect upon strata of a hard, unyielding nature, which would ultimately crack. Often these cracks (or veins), instead of rising vertically from below, pursue a considerable angle, and sometimes two cracks at no great distance from each other will take opposite directions, so that there is reason to believe that they 'hade' into each other and become one crack at no great depth from the surface. When this occurs, the intermediate strata between the two cracks, which are of a V or wedge form, is usually 'thrown down.' The cracks having widened into fissures by the Earth's expansion, the intermediate strata have slowly 'subsided.'" (*See* "The Constitution of the Earth," p. 362.) Water-courses have nearly in all instances originated in cracks, and although denudation has often played an important part in the existing conformation of valleys, they are mainly the result of an exceedingly slow separation of the two sides of what was once a crack. (*See* the article on 'Scepticism in Geology,' in "The Journal of Science" for June, 1881.) In making the foundations of the unfortunate Tay Bridge, evidence was discovered of what I take to be three distinct cracks, the result of the Earth's expansion. First, the primitive rock has split at a very remote period in geological history, and at the present time we find the two sides separated to the extent of a mile and a half. A gorge, 500 yards wide, was in the first instance slowly formed, which was filled up by sedimentary deposits, including red sandstone, which is now found immediately below the superficial clay. A second crack then took place, by which the red sandstone deposit was separated from the trap on the north side of the river. Over an immense period of time, this slowly widened out to the extent of more than a mile, during which further sedimentary deposits were formed. Between the latter and the red sandstone a third crack next occurred, and this is now filled up by soft material, which gave the bridge contractors a great deal of trouble. It is now about 300 yards wide. In a history of the Tay Bridge, given by Mr. Albert Grothe, we are told that, "after the fourteenth pier had been built, it was found that the rock suddenly dipped to a depth which was practically inaccessible, a discovery which led to a

complete change in the mode of procedure. No. 15 pier proved a most unfortunate one for the builders. Like the others, it was formed of two cylinders, but, being founded just where the rock dipped down, it began to cant over after being partially finished, and had ultimately to be blown down, and a new foundation prepared by means of piling." This piling had to be resorted to for six piers. I assume that the "dip down" was the result of the slow wearing down of the sharp sides of the red sandstone, after its separation from the trap rock, which is itself worn down on each side of the river. As a rule the harder rocks are the older. Consolidation may be said to be a law on this planet of ours, whether we follow the history of an animal, a plant, or a rock.

D. Y. C. says that "The new formations are found lying unconformably on older formations, each with their separate set of faults. And probably under these again would be found other sets." A striking evidence this of the truth of my theory of the Earth's expansion. It is only the more or less hard and brittle rock that cracks, just as only the dry bark of the older trees cracks as the result of their growth. Each particular rock or stratum has had its own history, during one period of which it formed the surface of the Earth, and when it may have been affected by the more demonstrative evidence of vital action in the shape of earthquake waves.

ANALYSES OF BOOKS.

Records of Sport and Military Life in Western India. By the late Lieut.-Col. T. G. FRASER. With an Introduction by Col. G. B. MALLESON, C.S.I. London: W. H. Allen.

WITH the introductory portion of this interesting book we shall concern ourselves merely by noticing Col. Malleson's assurance that the author was eminent for the virtue which scientific men value above all others—truthfulness. The first incident which we shall extract is one which in these days of revived occult philosophy will seem eminently worthy of notice. The author records the strangely fulfilled predictions of a Fakír, or mendicant devotee. The story was told him by the widow of a general merely designated by the initial W., doubtless well known at Bombay about A.D. 1823. The devotee, meeting Mrs. W., said to her—"'You are the wife of the General Sahib; you have a son and a daughter.' 'I had,' I remarked, 'but I have lately lost the former., 'No,' said the man, 'it is as I say. You are about to leave this country and go to your own.' (Now, I must here remark, my husband had repeatedly declared his intention never again to leave India.) 'Shall we arrive safe?' 'You will, but in fourteen days after you leave here he will be in the hands of God! In eighteen days you will be on board, and will leave everything here to be sold but one horse.' 'Here,' I exclaimed, 'is the stable, with several horses; show me the one he won't sell.' Running his eye rapidly down the line 'That one,' pointing to a grey, a birthday present from the General given me two days before. 'Shall I get home and see my child?' 'Yes,' said he, 'you will see your son as you are leaving this, but shall not speak to him; he will wave a cloth at a distance. You will arrive in Europe, remain there for a time, but your trouble for money will compel your return here; but you will again go back, and after a time your money will come, and you will be happy.'" This prediction was fulfilled to the letter. The same evening the General informed his wife of his intention to return to England. Everything was sold except the grey Arab. When passing the lighthouse a boat appeared vainly trying to overtake the ship, and with a glass a man was seen waving a handkerchief. It proved to have been the lady's son whose death had been falsely reported. In ten days from the time of sailing the General suddenly fell upon the deck and expired, as had been predicted on the fourteenth day.

We shall add no comments, but merely quote Col. Fraser's

declaration that Mrs. W. was a truthful lady, and totally free from superstition.

In a later part of the book an account is given of a Fakír who, at the court of Ranjit Singh, allowed himself to be entombed alive, and was resuscitated after the lapse of six weeks. As this incident has been repeatedly recorded, and has, so far as we are aware, never been called in question, there is no need for its repetition. We merely remark that here is a case of fasting much more signal than that of a late "Doctor."

Among the few facts on animal life here put on record must be mentioned the following, showing the tenacity of the black buck antelope of the Dekhan:—"A fore and hind leg, both fore or both hind legs, broken, these animals will still test your horse severely ere you can capture them; and I have seen a deer pass over more than 200 yards of rocky ground before he succumbed to a ball through the centre of his heart."

The author observed a striking instance that venomous serpents do not, as Waterton maintained, invariably confine themselves to defensive warfare. A dog barked at two cobras, which were in a field. "The snakes, immediately untwining, pursued the dog, which ran into the water. The snakes followed him instantly, and, swimming up to him, bit him so viciously that he died in half an hour." This is an interesting fact in snake lore.

Col. Fraser mentions a kind of wild dogs which run down deer in packs. He did not succeed in shooting one, but describes them as "somewhat smaller, but stouter built, than a jackal, a reddish brown inclined to black about the knees and feet."

Serpent-charming is described. A professional charmer was sent for to some outhouses in which dogs and poultry were sometimes found dead in the morning. The man was searched, in proof that he had no tame snakes secreted about his person, and then went to work. "He examined the rat-holes, and, selecting one, he commenced piping a reedy monotonous treble for some five or six minutes, when a cobra's head slowly emerged from the hole. With a forked stick he at once pinned the snake to the ground, and seizing it with the other hand behind the head, drew him gently out of the hole." In another shed the charmer captured another cobra in a similar manner, and put both into his basket. In proof that the man had actually enticed unsophisticated snakes from their retreats, he presented a fowl at the opening of the basket; it was bitten, and died in a few minutes. Moreover, the jaws of one of the snakes were opened for the inspection of the regimental surgeon, who clearly recognised the poison-fangs.

Of the prowess and ferocity of the tiger we find some fearful instances. One man is described as bitten at once through the shoulder-blades and the chest; another had the upper half of his skull bitten cleanly off, "as with a hatchet." Tigers frequently bear the marks of old gun-shot wounds about them. It

is a pity that, in dealing with such destructive animals, sportsmen do not see the necessity of using poisoned bullets. In like manner cobras might be routed from the vicinity of houses by the application of carbolic acid.

Rabies among jackals is noted as of common occurrence, Col. Fraser having shot one in this state which had entered his bungalow, and concealed itself under a chest of drawers. Pariah dogs also suffer from this malady, and communicate it to men. These facts are of some importance, since our English dog-worshippers maintain that rabies would disappear if dogs were not chained up and muzzled. The utter vanity of this contention is proved by the frequency of the disease among wild Canidæ.

Mention is made of the sudden and unaccountable appearance of cholera. Thus on a Sunday morning, in 1846, at Karachi, "all were well and healthy. A small lurid cloud was observed over the Biluch hills, the surgeon was called out from church, and by twelve that night a hundred cholera patients were in hospital: it lasted a week, and entombed seven hundred Europeans.

Another epidemic took place at Kolapur. A body of five thousand soldiers were encamped in the vicinity of the town, on a rising ground with a hard gravelly soil. On its flank was the escort of the Commissioner to which the author was attached, merely divided from the main body by a small rocky ravine, and having a large tank in its front. The first evening cholera broke out in the main camp, and on the third day the troops shifted ground after losing one hundred and fifty men daily. Meantime not a single case occurred either among the escort or in the town. If any contagion was being conveyed in the air, why were its effects so limited? Whether we suppose the *materies morbi* gaseous, or consisting of "figured" germs or spores, would seem to make little difference.

One more passage necessitates our attention. The author, "often and bitterly," had to lament his want of even rudimentary instruction in chemistry, geology, and botany." We have altered this matter: we do not "instruct" our officers and civil servants in the natural sciences, but we examine them therein, and thus delude both them and ourselves.

Every reader will, we think, like ourselves, lament that this book is not longer. Col. Fraser could doubtless have told us much more that would have been well worth reading.

The Ruling Mind manifesting itself in the Natural and the Supernatural. By A STUDENT OF NATURE. London: Hamilton, Adams, and Co.

THIS little work, though laying no claim to originality of thought or to scientific exactness, deserves much commendation for its clear and attractive style, and for the skill displayed in the development and illustration of its principal argument. It is divided into three sections, entitled respectively—"Has God forsaken the Earth?" "The Hand that never is Weary," and "The Outstretched Arm."

In the first, various processes of growth and secretion, such as the germination of a grain of wheat and the formation of a bird's feather, are lucidly described. The inference drawn is that the selective and formative power exercised by "Nature" can only be the attribute of a conscious and intelligent being, whom we must therefore regard as "the all-pervading Mind" or "the *actual present* Worker in the organic world around us."

In the second division " will be found the fundamental principle upon which the main argument rests—that all motion must necessarily be due to Mind, whether the motions be great or small; the most important illustrations of which, however, are to be found in the grand, unceasing, and generally inscrutable forces of Nature." This hypothesis—for, though stated in the form of an axiom, we can give it no higher rank—is of course supported by the supposed analogy of human volition, and illustrated by the facts of gravitation, and by other natural phenomena.

The third part is devoted to an argument in favour of the possibility and probability of "Miracles," founded upon the considerations adduced in the two former sections.

It will be seen that the teleology here expounded rests upon one great assumption, with which it must stand or fall. To those who deny the dual nature of man, and the government of Matter by Spirit, all this ingenious fabric of analogical reasoning will seem but a baseless and "unsubstantial pageant." For instance, the author asserts, as though it were a self-evident fact, that matter is, *per se*, incapable of thought, sensation, and desire, and therefore of purposive combinations. Surveying the organic and inorganic world, and finding throughout both traces of the adjustment of means to ends, he is forced by his preconceived idea to conclude these are manifestations of an omnipresent Spirit, distinct from the matter which it governs and the subordinate minds which it inspires. We will not here comment upon the inconsistency of a theory which represents the Supreme Being as at once finite and infinite, omnipresent and working by instruments or agents.

It is enough to remark that the results of modern physiological

and pathological research, combined with the every-day phenomena of life and death, prove the material brain to be a source of thought, feeling, and volition, beyond which neither reason nor experience can enable us to penetrate. Mind must, therefore, be considered as a function of matter, and as a result, not a cause, of that inherent energy which is manifested in the divers forces of organic and inorganic Nature. If what we call "design," as displayed both in human actions and in the seemingly azoic Cosmos, be regarded as of purely material origin, and not *caused*, though sometimes *accompanied*, by consciousness, the path is open for a theory of Evolution, in which Natural Selection and the Struggle for Existence would be only subordinate, though very powerful factors. The fallacy of such "demonstrations" as those relied upon by "A Student of Nature" consists in the assumption that matter is essentially passive, while all experience shows it to be in a condition of unceasing activity. He is of opinion that the motion of matter "must have had a commencement," but forgets to state the ground of his belief. Admitting that "it has not yet been proved that life is a distinct entity," he yet makes this claim for "mind," which is only a convenient name under which we group certain vital phenomena.

The usual arguments from "Personal Identity" are brought forward, and may be met by the usual answer. Memory is but one among a whole class of phenomena, most of which cannot be referred to spiritual unity. Old scars are retained through gradual changes of material, and even of form. The plant and the animal reproduce themselves in their offspring, which frequently manifest traits of individual resemblances to direct or remote progenitors. Yet it will scarcely be contended that the spirit of an ancestor can be propagated through a long line of descendants, perhaps remaining latent for generations, till it reveals itself at last in the great-great-grandson!

Facts like these are inexplicable; but so, indeed, is the universe of which they form a part: and we must earnestly deprecate the tendency to seize upon a supernatural *rationale* whenever a natural one does not immediately present itself. False metaphors and misleading illustrations, tending towards the personification of the laws and forces of Matter, have doubtless been too often employed by men of Science; and these our author does well to expose. His book may be read with pleasure and profit by those whose theory of the Cosmos differs most widely from his own.—C. N.

Experimental Researches into the Properties and Motions of Fluids, with Theoretical Deductions therefrom. By W. Ford Stanley. London: E. and F. N. Spon.

We have here before us the results of a prolonged and laborious inquiry into the theoretical conditions of the fluid state and the motive properties of forces in fluids. The author, some years ago, appears to have undertaken an experimental examination of the undulatory theory of light, and, as this theory is generally illustrated by similitudes taken from water-waves and sound-waves, he was led to examine these latter motions to be assured that the illustration is not misleading. He accordingly set about observing the motive effects evident in the directions taken by impressed forces in fluids under various principles of resistance. He came to the very legitimate conclusion that much work remains to be done before the principles of hydro-dynamics can be fixed with the needful precision. Some of this work he has attempted to do, and the results are presented in the present volume.

The first three chapters Mr. Stanley admits to be "speculative, and even in parts hypothetical."

In the second chapter, dealing with the conditions of liquid surfaces, he rejects the theory of tensile surfaces for liquids as recognised, *e.g.*, by Clerk Maxwell, and takes the opposite view, that such surfaces are *extensile* instead of *tensile*, "except for free films which are clearly tensile by the position of the attractive matter which composes them." These terms "tensile" and "extensile" he defines as follows:—"By *tensile* I intend a disposition of the parts of a system of matter to draw themselves together as a stretched drum-skin does. By *extensile* I intend the reverse of this, or the disposition of the parts of a system of matter to separate, and thereby to engender external pressures." He considers that his view is supported by the familiar experiment of floating a needle upon the surface of a vessel of water. He pronounces the subject, however, insufficiently worked out.

Some of the propositions in the third chapter will also, it is said, need partial correction. We notice especially the author's 106th proposition, which runs that "a projectile or a flowing force forming the head of a current before the continuity of projection can rotate a large volume of the resistant fluid laterally, will divide its direct current by constant bifurcation until the projectile force becomes in equilibrium with the forward resistance." This proposition he proves, or at least illustrates, by the following experiment:—"Take a pen full of ink, and place this gently upon the surface of the water in the trough (*i.e.*, a glass trough, narrow in proportion to its height). The ink, as it descends slowly by gravitation, will be found to divide constantly

upon the conic resistance which opposes its direct descent, the divided parts having insufficient momentum of projection to move the lateral fluid tangentially. After the first division the divided parts again divide, and these again, so that by this constant division and subdivision the projected fluid takes a tree-like form." In the author's illustration accompanying this description there appears, in fact, a series of regular bifurcations. On repeating the experiment with the blue aniline ink we always use, the result was different; the ink descended to the bottom of the trough in a long, very slender, thread, without any division at all. We then made several experiments with common black ink; we obtained results more like those figured by Mr. Stanley. There was division and re-division, sometimes into two, and at other times into three, branches.

The author endeavours to trace a similar action in the organic world:—"Such, for instance, as we find present in diffusion of liquids in the animal body, and the vegetable also under certain conditions; possibly more especially in the early development, or *setting out*, as it were, of the circulatory system. The principle of diffusion here demonstrated may prevail in the formation of the circulatory system within animal tissues,—that is, assuming the animal to be at first in a fluid or semi-fluid state, formed of matter possible [? capable] of after coagulation to the set form we witness. The intrusion of blood or other liquid with small force would of itself, by the natural fluid forces here defined, open out, through any inequality of resistance or by a constant pressure in one direction, a *reticulated system*, which would not only be composed of canals for the future transmission of the fluids, but the forms of such canals would be the least frictional for a constant flow through them afterwards."

In illustration, the author gives a microscopical view of the injected arteries of the bladder of the shrew, where bifurcation may in the main be recognised. The same form may, he contends, be traced in the veins of the liver, of the brain, of the mammary glands, and of certain tumours. This revival of iatromathematical speculation may be found worth a closer examination.

The author considers that plants have some power of engendering motive forces in the air for their own sustenance.

We hope that the specimen given may induce scientific men to examine for themselves a work full of suggestions which must interest the geologist, the meteorologist, and the chemist. The author's style is at times obscure, as may be seen from one at least of the passages we have quoted.

Bulletin of the United States Geological and Geographical Survey of the Territories, Vol. VI., No. 2. Washington: Government Printing-Office.

This issue opens with an Annotated List of the Birds of Nevada, by Dr. W. J. Hoffmann, with remarks on the distribution and vegetation as affecting the Avi-fauna. It is only natural that the fauna, both of birds and insects, should depend more on the character of the flora than on absolute height above the sea-level. In Nevada the common humming-bird (*Trochilus colubris*) occurs at an elevation of 9700 feet.

Next follows a List of North-American Moths, with a preliminary Catalogue of the Genera *Hadena* and *Polia*, by A. R. Grote.

Mr. J. H. Scudder has drawn up an account of the Tertiary Lake-Basin at Florissant, Colorado, one of the richest localities in the world for fossil plants and insects. Mention is made of a grove of petrified trees, probably Sequoias, which were formerly from 5 to 6 yards in height, but have been gradually destroyed by tourists. At the southern lake a section of about 7 yards was cut showing thirty distinct layers of shales, many of them fossiliferous. This locality has in a single season yielded more than double the number of specimens which Prof. Heer obtained from the Œningen beds in thirty years. The different orders of insects are by no means represented in the same proportions. At Œningen the Diptera form only 7 per cent, whilst at Florissant they rise to 30; the Hymenoptera are only 14 per cent in the former, and 40 in the latter. The Coleoptera are 48 per cent at Œningen, and only 13 per cent at Florissant. Among all the Florissant insects ants are the most numerous—mostly Formicidæ, a few Myrmicidæ, and some Poneridæ, but no Mutillidæ. Thirty species of Vespidæ have been detected; one, a *Polistes*, shows traces of a blue-green metallic colour. Only five butterflies have been found, generically distinct from any living forms, and there are perhaps eight species of nocturnal Lepidoptera. Among the numerous Diptera, Culicidæ, Chironomidæ, and Tipulidæ are abundant. Bibionidæ are the prevailing type. There are about fifty Asilidæ, some of them of great size. Of the Coleoptera two-fifths belong to the Curculionidæ. There are about thirty species of Carabs; no large Dytisci; thirty Lamellicornes; about as many Buprestidæ, some of which are very perfect. There are about forty species of Elateridæ, often in beautiful condition. There are some fifteen species of Longicornes; perhaps two dozen Chrysomelidæ, and 120 Curculionidæ. Hemiptera present a great variety of forms, but water-bugs, like water-beetles, are uncommon. There are about eight species of plant-lice. The spiders are uninteresting, and have few features in common with those found in the Prussian amber.

These remains, especially the presence of Termites, point to a much warmer climate than that of Florissant at the present day.

The next memoir is a division of the genus *Sciurus*, by Dr. E. L. Trouessart.

The two next papers—the Osteology of the North-American Tetraonidæ, and the Osteology of *Lanius Ludovicianus* var. *Excubitorides*, both by Dr. R. W. Shufeldt—we have already received by the courtesy of the author, and have noticed them accordingly.

There are further included in this volume a review of the Miocene Rodents of North America, and of the Canidæ of the Loup Fork Epoch, by E. D. Cope; and a paper by A. S. Packard, on a Crayfish from the Lower Tertiaries of Western Wyoming.

Osteology of the North-American Tetraonidæ. By Dr. R. W. Schufeldt, U.S.A.

This pamphlet is a reprint from the "Bulletin of the United States Geological and Geographical Survey" (Vol. vi., No. 2). The author, in the memoir befores us, confines himself to the family of the Tetraonidæ, or true grouse, as distinguished from the Odontophorinæ, the partridges and quails. In grouse North America is very rich, having representatives of the six genera *Tetrao*, *Centrocercus*, *Pediœcetes*, *Cupidonia*, *Bonasa*, and *Lagopus*. The author makes a very complete examination of the osteology of characteristic species of these six genera. His principal conclusion is that though—if we judge solely by outward appearance and structure—the American Tetraonidæ are well classified as they stand, yet that, judging from a purely osteological point of view, there is no valid reason why *Pediœcetes* and *Cupidona* should be referred to distinct genera. In their skeletons they are closely alike, whilst differing to a very marked degree from the other genera of the family. With commendable caution the author proposes to defer judgment pending a full examination of the structure of these birds in other respects.

Such monographs as the present are literally priceless data for the systematic naturalist.

We must call particular attention to the excellence of the illustrations.

Proceedings of the Bristol Naturalists' Society. New Series, Vol. III., Part 2. Bristol: J. Fawn and Son.

We have again the pleasure of finding the "Proceedings of the Bristol Society" containing, or rather composed of, sound, sterling, creditable matter.

Mr. W. J. Fuller, F.C.S., communicates some interesting results on the breathing apparatus of certain aquatic larvæ, chiefly Libellulidæ, but also including the Dipterous genera *Corethra* and *Chironomus*. In *Agrion*, *Libellula*, *Ephemera*, and *Corethra*, but not in *Chironomus*, the breathing apparatus serves as a means of locomotion.

Dr. Sylvanus Thompson attacks a very interesting physiological problem, to wit, by what means do we ascertain the direction of any sound which strikes our ears? This faculty, we may remark in passing, is possessed by certain of the lower animals, *e.g.*, cats, in greater perfection than by ourselves. He describes a number of curious experiments on the localisation of sound, but concludes that it is as yet impossible to decide "whether difference in phase, or direction or quality of the sounds that reach our two ears, is to be regarded as the criterion by which we judge of their direction."

Mr. J. Walter White gives some very sensible remarks on the preparation of a local flora. It is much to be regretted that the phyto-geography of England was not mainly completed a century ago. Since that time numbers of native species have disappeared from their localities in part owing to cultivation and building, but perhaps still more in consequence of the rapacity of collectors and plant-merchants. We quite agree with Mr. White that the localities of rare plants should not be too precisely indicated. We have known of collectors who were not so much anxious to obtain specimens of a rare plant as to leave none behind them, and who consequently would systematically root out every trace of the species in question in some locality.

Mr. C. Jecks, in a paper on "Darwinism," upholds Natural Selection as if not the principal cause of the rise and decay of species, yet one of considerable importance.

Mr. O. Giles describes the boulders of the Bromsgrove district, derived, it appears, from the Arenig mountains.

Mr. A. E. Hudd continues his catalogue of the Lepidoptera of the Bristol district.

Mr. C. Bucknall resumes his account of the Fungi of the Bristol district, and gives several species new to Britain. His memoir is illustrated with well-executed coloured plates.

Dr. G. F. Burder summarises the results of modern investigations on the course of storms. He points out that during January, 1880, there was no atmospheric disturbance of moment in Western Europe, from the 4th to the 27th day inclusive. Yet

during this same interval *nine* storms were announced from America as "threatening the British, French, and Norwegian coasts." He quotes from Prof. Loomis an amusing instance of a storm-centre which started from a spot to the south of Greenland, and moved for some days in a regular course eastwards; then turned back, and after a fortnight was not far from the point where it arose; then taking a fresh start eastwards, it finally reached the coast of Norway.

M. A. Leipner, F.Z.S., the able and zealous Secretary of the Society, communicates "A Naturalist's Ramble in Guernsey." He regrets the absence of a local Naturalists' Society, which would find ample work, especially in Marine Zoology. No fewer than sixty-two species of Polyzoa were obtained in one dredging expedition of four hours! The island would be an admirable locality for a station like that of Roscoff, and for an aquarium in the true sense of the word.

A passage copied from the "Beaufort Courier" (South Africa) describes the successful use of ipecacuanha for the bites of venomous serments, including the "puff-adder," which, we believe, is a *Naja* akin to the cobra of India.

Another South-African paper, the "Frontier Guardian," gives a curious account of a battle between a crow and a serpent of the "ring hals" species, in which the former was victorious. It is stated that about twenty other crows were present as spectators, taking no part in the struggle, but testifying their pleasure at the final success of their companion by loud cawings.

We must again congratulate the Bristol Naturalists' Society on the work it is doing, and on the character of its "Proceedings."

A Manual of Sugar Analysis. Including the Applications in General of Analytical Methods to the Sugar Industry; with an Introduction on the Chemistry of Cane-sugar, Dextrose, Levulose, and Milk-sugar. By J. H. TUCKER, Ph.D. New York: D. van Nostrand.

CONSIDERING that we are, nationally, the greatest sugar consumers in the world, and might be if so disposed—with the single exception of Brazil—the greatest sugar-producers also, the little attention which has been paid in this country to the chemistry of so important a substance is a striking instance of apathy. That we should have to derive instruction on such a subject from any continental nation would little have been dreamed of by our ancestors in the last century. Everyone knows that beet-root sugar

was originally one of the weapons devised against England by the first Napoleon. On his fall it was not laid aside, but was vigorously wielded by several countries. The new manufacture was fostered by protective duties and by export bounties, but, above all, its rise and progress were due to technological skill. Every point of the chemistry of sugar-making and refining was carefully and perseveringly studied, whilst we looked on in indifference. The consequence is that our rivals have at last brought forward a product which, if from some hidden cause less pleasant to the taste, appears analytically on a level with the best produce of the cane.

The work before us is designed to furnish English readers with the needful information on the analysis of sugars, saccharine juices, syrups, &c. The author begins with the chemistry of the sugars in general, and proceeds to saccharose, the sugar of the cane, and, as is generally supposed, of the beet-root, though doubts on this head are beginning to arise. Mention is made of strontium sucrate, formed by adding the hydrate of strontia in a solution of sugar, but we do not find a notice of the use of this earth as a substitute for lime in sugar-refining.

Dr. Tucker next passes on to dextrose, levulose, and invert sugar. He then discusses the determination of the specific gravity of saccharine solutions, introducing Baumé and omitting Twaddle. We find next the optical methods for the determination of cane-sugar, the requisite instruments being described and figured. He then proceeds to the chemical methods for the determination of cane-sugar; the instructions for the determination of dextrose and invert sugar, and for the analysis of raw sugar, treacle, cane and cane-juice, beet-root and its juice, and, lastly, the waste products, are quite on a level with the latest researches, and if they may—as we suspect—not work quite satisfactorily the fault lies not with the author.

Notice is taken of one of the growing frauds of the day—the use of starch-sugar or corn-sugar in adulterating raw sugars, syrups, honey, preserved fruits, sweetmeats, and a long list of other eatables. Nor must beverages here be excluded, since wines are now often made by fermenting a solution of starch-sugar upon the marc of pressed grapes. One of the most critical symptoms shown by society as organised on the industrial type is the tendency to apply every invention to fraudulent purposes.

Dr. Tucker's work fills up an important vacancy in the chemical literature of our common language, and will doubtless meet with wide appreciation.

Report of the Entomologist of the United States Department of Agriculture for the year 1880. By J. H. Comstock. Washington: Government Printing-Office.

In the United States, much more than in any other country, the damage done by insects to various crops is being closely scrutinised, and the habits of these destroyers are carefully studied with a view of finding out means of limiting their ravages. Whether this judicious activity is due simply to the practical good sense of our Transatlantic neighbours, or is forced upon them by the fecundity of certain insect species under their warm summer suns, it is not necessary to inquire. But we may safely assume that the investigations of Mr. Comstock and his colleagues will be of great service to agriculture all over the world, besides bringing in a rich harvest of purely scientific observations. One of the facts most frequently forced upon the mind, in reading these reports, is the mutability of animal habits.

Closet-naturalists of the old school, and even some out-door observers who confined their researches to some limited sphere, always tell us that every animal species is placed by Nature in the locality best suited to its existence and propagation, and that its choice of di et and general habits are dependent upon primordial and unvarying instincts. In contradiction to such statements we find that a species on finding its way into some new region flourishes and multiplies to an extent unknown before. An insect may have long been recognised in Europe as practically harmless. Take it to America, and it may become a serious nuisance.

In the volume before us a remarkable change of habits is recorded in the scolytid beetle, *Monarthrum fasciatum*, which perforates the heads and staves of casks, letting the contents leak out. Formerly these enemies were kept at bay by painting the casks with white lead, but "latterly they hardly wait for the casks to dry before commencing their attacks."

The greater part of this report is taken up with a thorough examination of the Coccidæ, or scale-insects, a tribe very destructive to vegetation in tropical and semi-tropical countries, and which are unfortunately cherished and defended by the ants, which even re-introduce them on trees where they have been destroyed. Mr. Comstock considers soap-lye the most effectual remedy.

Geological Survey of Alabama. Report and Progress for 1879 and 1880, By E. A. SMITH, Ph.D., State Geologist. Montgomery: Allred and Beers.

THE principal feature in this report is the exploration of the coal deposits of the Warrior Basin. In a section of 2600 feet there are from thirty to thirty-five seams of coal, of different thickness and quality. Many samples have been analysed, and the sulphur is found to vary from 0·4 to 2·75 per cent. The latter quality, if extensively used, cannot fail to have a very injurious effect on vegetation, from the quantity of sulphurous acid poured into the atmosphere.

The Whole Art of Marbling, as applied to Paper, Book-edges, &c. Containing a Full Description of the Nature and Properties of the Materials used, the Method of Preparing them, and of executing every kind of Marbling in use at the Present Time; with numerous Illustrations and Examples. By C. W. WOOLNOUGH. 82 pages; 31 specimens. London: George Bell and Sons.

THE marbled papers so commonly used for the linings and covers of books are familiar to everyone, but very few have any idea of the process by which the curious, irregular, but often delicate and harmoniously coloured, patterns are produced.

The former edition of Mr. Woolnough's book, published more than twenty-seven years ago, has for some time become very scarce, and many improvements have taken place during that period which are embodied in the present issue.

The exact date of the introduction of marbled paper is unknown, but it is found on old Dutch books of the beginning of the seventeenth century, and was known in Spain at least a hundred years ago. This country was formerly supplied from Holland, a considerable quantity of the paper finding its way here wrapped round parcels of toys, and by this means of importation escaping the payment of a very high duty.

The author explains very much in detail the whole of the implements and materials employed, many of which, especially the colours, require great care both in selection and preparation.

The process may be described as a peculiar kind of printing, the impression being taken on the paper from the surface of a mucilaginous fluid, by being carefully laid upon it after the pattern has been prepared. The medium used is generally gum tragacanth, which, when soaked in water, does not entirely dissolve, as is the case with gum Arabic, but forms a somewhat

gelatinous mass: this solution is, for certain patterns or for the sake of economy, sometimes modified by mixture with the mucilage extracted from various seeds by soaking in hot water.

Upon the surface of a bath thus prepared, the colours—which are ground in water and tempered with a wax medium, partly to fix the colours on the paper, and partly to facilitate the glazing process used in completing the paper—are thrown or sprinkled, according to the effect to be produced, each succeeding colour having a little more ox-gall mixed with it, which causes it to spread and drive before it the other pigments in which the proportion of gall is somewhat smaller, the result being a surface covered with variously coloured spots and veins: these, in some patterns, receive modifications by combing and curling with a few simple tools.

The examples of paper in various progressive stages assist greatly in the understanding of the various modes of working—a matter rather difficult to understand without such assistance. The specimens given are numerous, and the reader cannot help being struck with the great beauty of many of the patterns.

Mr. Woolnough considers that there is much scope for further progress in the art, and that chemistry might be pressed into its service with every probability of discovering new means of working.

A detailed account is given of the way of making the whole of the patterns described in the book.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

DISUNION IN THE CAMP: VIVISECTION.

"THE public must be educated. . . . The claims must be definite. It must be clearly understood *that the right we contend for is not that of* FREE '*vivisection*,' *free alike to the student and teacher, the tyro and skilled experimenter. Nor do we claim the right of vivisection for the mere purposes of demonstration.* But we do claim that skilled experimenters—physiologists, pathologists, and pharmacologists—shall have perfect freedom to conduct experiments on living animals, where such are necessary to the elucidation of the problems of health, disease, and therapeutics. . . . The only way of successfully contending against the agitation now on foot is to diffuse a knowledge of the truth." —EDITOR of *Lancet*, p. 343, August 20, 1881.

"The Act apparently contemplates, as the chief subjects of its operation, an imaginary class of unqualified persons, who, with no legitimate relation to scientific research, would under pretence of such research torture, and it is supposed take pleasure in torturing, living animals; and against this devilish class of persons the Act is very indulgently framed; for instead of expressly refusing to license unqualified persons, and perhaps hinting to such of them as would do wilful cruelty, under pretence of study, that the cart and treadmill are for such scoundrels; instead of this, I say, the Act virtually confounds together this imaginary class of unqualified and cruel persons, and, on the other hand, our professional class of *bona fide* scientific workers. . . . What is counted good for one class is counted good for the other."—SIMON, Address International Medical Congress, 1881; *Lancet*, p. 323, August 20, 1881.

To the Editor of the Journal of Science.

SIR,—I have placed two paragraphs at the head of this letter. My remarks on vivisection—or, as in my lecture I called it,

animal experimentation—must be read by the light of these extracts.

I regret that you have not read my lecture *in extenso;* an abstract does not convey sufficiently clearly what I said. I shall have pleasure in sending you MSS., from which you will see that I lead up to the subject of animal experimentation by illustrations of what commerce, science, life, health had gained by the labours of the men who conducted experiments on living animals.

I am glad you give me credit for good intentions.

I did imagine that I was carrying out the programme sketched in the "Lancet," and that I would best advance the interests of the side I was taking by mild temperate language, so that any ardent "anti-vivisectionists" in the room might see that I did not depend on abuse, vituperation, or calling names, to support my cause.

This was the second occasion on which I spoke publicly in favour of the claims of physiologists—non-medical—to conduct experiments on living animals without the needless and harassing restrictions which are now imposed on them. On both occasions my audience listened to me with attention; on both occasions my views seemed to meet with favour. This concurrence was due to the fact that I did not call my opponents "fanatics," "fools," or hurl other unpleasant epithets at them. Because the parties opposed to scientific advancement heap abuse on such men as Michael Foster, Balfour, &c., it does not follow that we should imitate their bad example, or retort by the free use of strong language.

I need not offer any further excuse for my views. We differ as to our method of warfare. You may be right. I, however, venture to think that my method is more likely to make converts to the cause we both have at heart. As a soft word turns away wrath, so temperate language may have an effect upon those who are now prejudiced against skilled animal experimentation. Is there disunion in the camp? Do we ask for total repeal of the Vivisection Act? Do we demand free vivisection for all?

The "Lancet" may be taken as a fair representative of medical views; perhaps I might even say it represents the opinions of a large camp—the physiologists, biologists, chemists who have done so much for medicine.

The views of the "Lancet" I have adopted, so that if I have compromised the movement your indignation must be vented not only on me, but on the leading journal of medical opinion.

I do not imagine that you can seriously ask for free power of animal experimentation for all, the competent and the incompetent, the novice and the master,—that in the name of Science you consider such unlicensed and unfettered experimentation necessary or advisable. If you do then certainly there is disunion in the camp; but in which camp? You are striking out

a line of your own, into which I cannot follow you. I am not considering this question from a purely medical, selfish point of view. I am willing and anxious that all biologists—scientists, if I may use the word—should have the power of carrying on experiments, likely to prove useful to science and mankind, without the restrictions now imposed on them. Competency or fitness for scientific research should be a *sine qua non* with all who engage in such experiments. Who is to vouch for this? There cannot be much difficulty on this point, with the number of learned societies we have. All the young workers soon get known to the leaders in Science in all its departments.

I do not see much humiliation in the certificate, provided it covers the conditions I ask for, viz., that the licensed experimenter may carry on any or all experiments he may think necessary, without the present harassing restrictions. The certificate will be a guarantee that the worker has a definite object in view, and that he understands the manner and methods of research.

You object to my expressions about "torturing a living animal under pretence of research." If you read Simon's Address you will see he alludes to the class (imaginary or not) who, with no relation to scientific research, carry on animal experiments. If there are such a class, then I say let the Act stand in force against them. I asked my audience to discriminate between the qualified and unqualified, and pointed out the injustice of applying the Act equally to both. I have nothing to retract on this point. I do not consider it any hardship to limit experimentation to the class of scientific workers who are anxious to undertake this kind of work—chemist, physicist, surgeon, or physician. In my lecture I clearly point out what I desired for them. Pasteur would not suffer from my conditions if he lived in England.

In grasping at the impossible you may lose the possible. In the present temper of English society I feel that a repeal of the Vivisection Act *in toto*, in favour of free and open vivisection, is an impossibility.

The "Lancet" programme is within the range of practical politics. The disunion in the camp need not any longer continue if you will substitute it for your own, and use your powerful pen in advocacy thereof.

Medical men, biologists, naturalists will derive equal benefit from the Act if it is administered in the spirit and manner I suggest, so that there need be no division of interest.

I regret that my method of educating the public has met with your disapproval. I have the satisfaction of knowing that our scientific men here, outside my own profession, approve of the manner in which I treated this subject.

I distributed 250 copies of Professor Humphrey's Address to my audience, so that if I did any harm his able *exposé* will have neutralised it.—I am, &c.,

T. M. Dolan.

Horton House, Halifax, January 4, 1882.

HYLO-PHENOMENALISM THE SUMMA SCIENTIÆ.

"Cœlum ipsum petimus Scientia."

To the Editor of the Journal of Science.

SIR,—May I venture to claim, in the interest of Science and Philosophy, a small space in your Journal for a few brief remarks in further elucidation and development of some recent contributions to your pages by C. N., under the title of Hylozoism, or Materialism, as opposed to Animism? Without further preamble let me state that the Hylozoic theorem of Life and the World may be formulated as the utter self-evident impossibility—in the nature of things—to transcend or escape in any way from the limits of our own anatomy,—of our own conscious Ego,—the Non-Ego, or falsely so-called "external Universe," being but the objective, or projective, image of our own Egoity, not the *vera effigies*, or absolute substance, of any "thing" external to Self. In other words, that all "things" or entities, or non-entities,—abstract or concrete,—from Divinity downwards, are merely ideal or phenomenal imagery of our own Mind—the essential physical basis, proplasm, or officina of which is the vesiculo-neurine or grey tissue of the encephalic hemispherical ganglia: that, in still more concise terms, Being is Perception and Conception (Ideation), which apparently two abstractions are virtually one,—the function, namely, of a somatic organism,—itself "*fons etorigo*" of all Cognition. On this view of Nature and Mind I trust your enlightened readers will be enabled to realise without difficulty, and as a *self-evident* fact and principle, my corollary, that the only "Spirit" or "Anima Mundi" accessible to us is the animal life on the earth, and, in the last analysis, our own consciousness, by which alone we feel "we live, move, and have our being," or, in less mystic phraseology, are cognizant of motion and sensation. So that no objection can be valid against Hylo-idealism, on the score of any contradiction between Determinism or Necessity, and Self-Determinism or Free Will; the seemingly two being really—*i.e.*, ideally, or phenomenally, or relatively—identical; the Absolute being to Man an inaccessible *Terra Incognita*. Let me illustrate the reconciliation still further by quoting a fallacy embodied in a couplet of Pope's "Universal Prayer":—

> "And binding Nature fast in Fate,
> Left free the human Will."

Surely it is clear and *self-evident*, on this theorem of Hylo-Idealism,—the sole legitimate creed, as I contend, of modern

Physics and Physiology,—that though Fate or Natural Law presents itself to our conscious Ego, in the domain of Cosmical Science, "as if" rigidly immutable and inexorable, yet as this Law, which includes Gravitation or the self-activity of Matter, is one with the law of our own organisation,—is, indeed, as Mr. Ward ably shows in your January issue, a purely mental abstraction, not an *absolute* force in "Nature, as vulgar Realism conceives it,*—and thus only a fiction, or imaginary or esoteric enactment of our own brain, the whole question of Free Will and Necessity resolves itself into a Skiamachy, or dance of shadows. I find this view a perfect Eirenicon on the momentous question of free will and human responsibility to any Power other than Self. "We *must* must," but the compulsion is none, since it is a law of *our own* nature, and is thus transformed into the law of perfect Liberty. Exact Science has been justly defined by some of its most competent contemporary authorities as "*only*" reasoned out Common Sense. Surely all Speculation which cannot be brought to that test is condemned as anarchic by sound Reason,—acknowledged by the ablest apologist of Animism and Christianity, Bishop Butler, to be the plenipotent judge even of "Divine Revelation" itself. Certainly modern Nosology has identified all "sacred" and "profane" manifestations of Animism, or Spiritology, as it is called by Guiteau, the latest pretender to "Divine Inspiration," with quite ordinary symptoms of disordered cerebration, "familiar as household words" to every clinical tyro, especially in the department of alienistic medicine. I need hardly add that this vital and physical thesis quite excludes all trustworthy knowledge as to any power of an animistic kind "behind" or "above" Nature or Brain, the officina—or, indeed, artifex—of Nature leaving us in the state of quite satisfactory Agnosticism, "*Ne sutor ultra crepidam.*" The very keystone of Hylo-Phenomenalism is the impossibility of affirmation or negation, as regards any "phenomena," outside the subjective universe of Self—our only "Final Cause." The whole universe of things and thought is, indeed, on this view, only an Auto-morphosis,—each Ego being to itself, as Protogoras postulated, the measure and standard of all existing things, of all thought, and of all objects of thought whatsoever, and actual altruism being but a dream. The animistic or spiritual heresy is thus relegated into the limbo of Mysticism, defined in the last (eighth) edition of the "Encyclopedia Brit."

* Mr. Ward's precise words, in his letter entitled "Professor Ball's Glimpses through the Corridors of Time," are—"The Professor obviously believes that Gravitation is an absolute Force in Nature, and not, as Newton taught, a purely abstract" [*i. e.*, ideal or hylo-phenomenal] "conception of the laws or principles of motion." I may mention that Professor Tyndall takes the same absolutely real view as Mr. Ward imputes to the distinguished Astronomer Royal of Ireland, and rejects the theory of Hylo Phenomenalism, or nineteenth century Nominalism (*see* M. Littre's Dictionnaire), as a quite visionary *schwindel* and wild mental aberration, unworthy of scientific notice.

as "that form of error, whether in Religion or Philosophy, *which mistakes the operation of a merely human faculty*" [or organic function—the Italics are mine] "*for Divine*" [or any other animistic] "*manifestations.*"—I am, &c.,

ROBERT LEWINS, M.D.

Army and Navy Club, January 11, 1882.

GEOLOGICAL RESULTS: SUGGESTIONS.

To the Editor of The Journal of Science.

SIR,—In my letter last month I omitted to state (what may possibly have at once presented itself to many minds) that faults of the kind referred to, instead of being roughly like a Y, are more likely to be X-shaped, or crossed; in which case the explanation would be obvious, viz., first one fault occurred, and then a second definitely afterwards, across the former, indications whereof could be traced by inspection. But is it so? I am inclined to think the Y-shape are the more likely.

In case there was not the continuation at all, at the V base, I should suggest it was the result of an upheaval, where the ground opened fan-like; therefore it is possible such would be found wider at the top of the individual fault itself than at the base, and the wedge might have slipped farther in, thus presenting a peculiar appearance. However, these are but suggestions thrown out for what they are worth.—I am, &c.,

D. Y. C.

Leeds.

NOTES.

Dr. Lund ("Comptes Rendus") has discovered fossil human skulls in the caverns of Lagoa Santa. He considers that in America, as well as in Europe, man existed along with various mammals now extinct. The Brazilian skulls are distinguished from those found in Europe by a combination of dolicocephalism and of hypsistenocephalism.

M. E. Bourquelot shows, in a communication to the Academy of Sciences, that the liver and the pancreas of the Cephalopods produce, or at least contain, a ferment which has no action upon crude starch, but which transforms hydrated starch into sugar.

M. Jobert ("Comptes Rendus") has brought to light a remarkable instance of parthenogenesis in *Eumolpus vitæ*, a Chrysomelid beetle very destructive to the vine. The author has dissected 3728 specimens without finding a single male. The "samen kapsel" of the females never contains spermatozoids, yet the eggs are always fertile.

Mr. E. A. Axon ("Comptes Rendus") gives cases of deaf-mutes who on being taught to articulate were found to have the peculiar accent of their native district, which they had never heard. Some naturalist would call this "instinct!"

M. Brown-Sequard, in a communication to the Academy of Sciences, concludes that a number of parts of the nervous system may act suddenly, or very rapidly, in a purely dynamic manner, and without the intervention of nutrition upon other parts of this system, so as to increase the power of action of the latter.

The conclusions drawn from the recent French dredging expedition in the Mediterranean are that this sea cannot be considered as forming a distinct geological province, but that it has been peopled by immigration from the ocean.

MM. Grasset and Amblard ("Comptes Rendus") maintain, as the result of recent experiments, that morphine is not diametrically opposed to thebaine, but has to a certain degree the characteristic property of the latter. The excitometer effects of opium must not be exclusively ascribed to the "convulsivant" alkaloids, but in part to those which are considered soporific. The action of morphia upon Mammalia is not opposed to its action upon the frog.

According to M. F. Jean the tannin of wines, derived from the seeds and the stalks of the grape, gives a greenish black colouration with ferric chloride. Any other colour indicates the presence of an astringent body foreign to wine.

M. Tacchini ("Comptes Rendus") concludes, from spectroscopic observations, that hydrocarbons are always present in comets.

Acanthephyra purpurea, found at the depth of 2590 metres near the Berlinguer, is of a splendid carmine-red colour.

M. Faye ("Comptes Rendus") combats the notion that a series of circumpolar stations would be of importance for meteorological observations.

N. Pringsheim, in a memoir communicated to the Berlin Academy of Sciences, discusses the primary actions of light upon vegetation. These actions, he concludes, consist in thermic and photo-chemical effects, the influence of which can be directly recognised in the several constituents of the illuminated cell.

We are happy to learn that the Harveian Society have passed a unanimous vote of congratulation to Prof. Ferrier on "the happy result of the fanatical prosecution to which he has been subjected.

According to M. Davaine ("Comptes Rendus") the speed with which the virus of glanders is absorbed, when introduced under the skin, varies greatly.

M. Fano, in a communication to the Academy of Sciences, shows that the choroid membrane of the eye has a more important function than that commonly ascribed to it, and has a decided influence on the distinctness of vision.

J. D. Caton ("American Naturalist") gives some interesting particulars on the changes in domesticated animals if allowed to run wild.

M. C. de Merejowski ("Comptes Rendus") gives an account of a red colouring-matter (tetronerythrine) present among various groups of Cœlenterata, Echinodermata, Crustacea, Mollusca, and fishes. He considers that, like hæmoglobine, it subserves respiration, in this case cutaneous.

Rev. L. J. Templin ("Kansas Review of Science") describes the large wasp *Pepsis formosa*, known as the Tarantula (*Mygale Hentzii*) killer. It hunts for its prey by scent, paralyses it by a sting, and carries off the body as provision for its nest. It refuses a Tarantula which has been killed.

W. H. Dale ("American Naturalist") describes a tame snail—species not named—which would come if called by a little girl

who used to feed it, but withdraw into its shell if anyone else spoke.

J. E. Todd ("American Naturalist") reports an instance of an *Asilus*, about three-fourths of an inch in length, which had succeeded in capturing a dragonfly, and was sucking its juices.

M. E. Blanchard ("Comptes Rendus") argues, from the general identity of the flora and fauna of the African, European, and Asiatic coasts of the Mediterranean, that this sea is of recent origin. To this it is replied, that the similarity of organic forms is explained by the former existence of a neck of land connecting Spain and Africa, and another stretching from Sicily to Tunis.

According to M. Rolland the Artesian wells in the oasis of Constantine contain several species of mollusks, crabs, and fishes found in the surface waters of the region.

We extract the following passage from "Light" (December 31, 1881). Col. Olcott one afternoon visited Forest Hills Cemetery, and on the spur of the moment devised the following test:—"Passing through the greenhouses my attention was struck by a curious plant, with long narrow leaves striped with white and pale green. It was the *Dracæna Regina*. With my blue pencil I marked on one of the leaves the cabalistic sign of the interlaced triangles, and requested the Spirits to bring it to me at the circle the following evening. I purposely sat at Mrs. Thayer's right hand, and held her hands, when suddenly I felt something cool and moist drop upon my hand, and when the candle was lit *found it to be my marked leaf. I went to the greenhouse, and found that the leaf selected by me had actually been broken off.*" I need make no apology for preserving testimony of this nature to the facts of mediumship so remarkable as Mrs. Thayer's. Col. Olcott afterwards put her in a bag, and otherwise rendered her helpless in her normal state, but still flowers, peaches, and birds were produced. One point further is worth notice. These flowers were of natural growth. Whence did they come? In a few cases from neighbouring gardens; in most, from an unascertained source. By what means were they severed? Colonel Olcott examined the stalks. "They had been broken off—not short off, but with a thin ribbon of bark at one side; and around the fracture, in almost every case, was a little ring of black, as though an electrical current had effected some chemical change in the chlorophyll." This may be significant.

The age of the Mediterranean has latterly become a subject of discussion among French geologists.

M. P. Cazeneuve ("Comptes Rendus") has examined the secretion of uric acid in birds. He concludes that in different

species the decomposition of the albumenoids is effected according to special equations. This decomposition being probably connected with the phenomena of hydration, rather than of oxidation, the ingestion or the privation of oxygen makes little difference.

Prof. Elsberg ("Science") proposes the term "plastid" in place of "cell."

M. Grand' Eury, in a communication to the Academy of Sciences, maintains that during the Palæozoic epoch the Ural Mountains separated two seas.

H. Sprung ("Naturforscher") considers that there may be traced a daily periodicity in the direction and in the force of the wind.

M. Carl Vogt ("Comptes Rendus") has examined the alleged meteoric organisms of M. Hahn, and finds that they are produced merely by crystalline conformations, purely inorganic.

(This announcement will for the present extinguish much speculation as to the dawn of life upon our globe. The "moss-covered fragment" must again be banished to the realms of conjecture.)

M. V. Lémoine ("Comptes Rendus") describes the *Gastornis*, a gigantic fossil bird with wings unfit for flight, but which may possibly have served for swimming. This bird has some analogies with the Cursores and the Palmipedes, but forms, upon the whole, a type distinct from all known at present, and is in many respects reptilian.

M. Laulanié ("Comptes Rendus") shows that the specific agent of tuberculosis acts in the same manner as the ova of *Strongylus vasorum*.

According to M. Paul Bert ("Journal de Therapeutique") special venoms are secreted by the toad, salamander, newt, frog, &c. From the glands on the neck of the frog he has collected a liquid which if injected into a sparrow occasions death with convulsions, the heart being arrested in systole.

M. W. G. Levison, of Brooklyn, has examined the spectrum of the light of the firefly (? species). He finds that the blue and violet rays are absent, and that the less refrangible rays predominate.

MM. A. Dumontpallier and P. Magnin ("Comptes Rendus") consider that there exists in the dorso-lumbar region of the spinal marrow an inter-crossing of the sentient and motor fibres, which accounts for the simultaneous movement of an anterior member of the one side and a posterior member of the other.

(These movements, however, are not strictly simultaneous.)

We learn with delight that an anti-vivisectionist who subscribes £20 yearly towards carrying on the anti-scientific agitation has been fined for maltreating an "unoffending" animal in his possession. How much a revised and enlarged edition of the "Devil's Walk on Earth" is needed!

M. Schützenberger, in experimenting upon the petroleums of the Caucasus, has observed facts which seem to show that the atomic weight of the elements are not absolutely fixed, but may vary within certain narrow limits. Petroleum, aniline, and benzol, if distilled in contact with sodium and kept in the dark, give on analysis 101 to 101·5 per cent of carbon and hydrogen; but if exposed to the light for two hours the yield is only 100 per cent.

The "Magdeborgische Zeitung" has established a meteorological observatory, well equipped and placed in competent hands. The object is the benefit of agriculture.

According to "Ciel et Terre" two new small planets have been discovered during the past year, raising the total number of the group of worlds between the orbits of Mars and Jupiter to 220.

M. Dufour, in a paper read before the Helvetic Society of Natural Sciences, points out that in calm weather the images of distant objects, reflected in the Lake of Geneva, appear distorted exactly as calculation shows they ought to be in consequence of the figure of the earth. This is a new and excellent proof that the earth is round.

The "Pall Mall Gazette," criticising Shairp's "Lectures on Poetry, writes:—"Chamæleon's food is light and air; the molar teeth of a man indicate more substantial diet; we need even silicious particles to form the bones." Chamæleons are in these days found to feed upon insects, and the mineral part of our bones, on analysis, proves to be formed not of "silicious particles," but of salts of lime and magnesia.

The new Science College at Birmingham has already stultified itself. The governing body have refused to allow Dr. Haycraft, their Professor of Physiology, to apply for a license under the Experiments on Animals Act.

It is rumoured that the Natural History Professorship at the University of Edinburgh has been offered to Dr. F. M. Balfour.

Dr. Conrad Keller, Professor of Zoology at Zürich, is engaged in a scientific exploration of the coasts of the Red Sea.

According to the "Gazzetta Chimica" potassium ferricyanide (the red prussiate of potash) cannot be used for distinguishing the ptomaines from vegetable bases, since, contrary to the assertion of MM. Brouerdel and Boutmy, it is reduced by both.

Original Researches.—The Royal Society of New South Wales offers a Prize for the best communication, containing the results of original research or observation, upon each of the following subjects :—

Series I.—To be sent in not later than September 30th, 1882.

No. 1. On the Aborigines of New South Wales, £25.
2. On the treatment of auriferous pyrites, £25.
3. On the forage plants indigenous to New South Wales, £25.
4. On the influence of the Australian climates and pastures upon the growth of wool, £25.

Series II.—To be sent in not later than August 31st, 1883.

No. 5. On the chemistry of the Australian gums and resins, £25.
6. On water supply in the *interior* of New South Wales, £25.
7. On the embryology and development of the marsupials, £25.
8. On the Infusoria peculiar to Australia, £25.

The competition is in no way confined to Members of the Society, nor to residents in Australia, but is open to all without any restriction whatever, excepting that a prize will not be awarded to a Member of the Council for the time being ; neither will an award be made for a mere compilation, however meritorious in its way—the communication to be successful must be either wholly or in part the result of original observation or research on the part of the contributor. The successful papers will be published in the Society's annual volume. Fifty reprint copies will be furnished to the author free of expense. It is the intention of the Society to offer additional prizes should this first attempt to encourage original scientific investigation be reasonably successful.—A. Liversidge, A. Leibius, Hon. Secs.—The Society's House, 37, Elizabeth Street, Sydney, November 2, 1881.

We extract from "Light" the following theoretical view of the interior of the globe :—"Here, at what we call the centre of the earth, I see a small globe enveloped with a crust or shell ; the space within the said shell I designate No. 1 Space, and its crust I call No. 1 Crust, the whole of which forms a small globe which I name the Primal Globe. This globe may, with due propriety, be termed the heart of the earth. It seems to revolve on its own axis with great velocity, much quicker than the superincumbent spheres. Within this Primal Globe is the grand source or fountain of all life upon this planet. Within this Primal Globe exists a light surpassing the light of the sun in brilliancy. This light existed, it might be, for millions of ages prior to the crust ; it then revolved in space like some bright star, and, as it at the

first was not so much condensed as now, it might at some far back period have resembled a comet. Here, then, I find the one chief factor of all earthly existences. I observe that the north and south points of this inner globe, as well as those of our globe, are not simply flattened, but are slightly concave. This is the result of attraction at these points being so intense,—similar to the end of an apple or orange, which is not flat, but slightly indented."

"Truth" gives a pen-and-ink sketch of Prof. E. Ray Lankester which is at any rate instructive as showing what the modern fast *litterateur* thinks of the modern man of Science. We implicitly believe the writer when he says that he would prefer the society of a "healthy fool" to that of the learned Professor!

Prof. Meehan ("Kansas City Review of Science") decides that the timber line of high mountain-tops results from the washing down of the earth from the higher elevations.

The overthrow of the Gambetta Administration involves a loss to Science in the removal of Dr. Paul Bert from the ministry of Public Instruction.

A daily paper for the 17th ult. speaks of the "sodium of calcium" as a dangerous compound.

"Light" contains a great—and we may say an increasing—array of incidents which demand serious consideration. In many cases the stale explanations of trickery or of "DOMINANT IDEAS" are utterly inexplicable. We do not, however, like the form of Signor Damiani's challenge to Professor Huxley. It is substantially a bet, and betting is, in our opinion, "ultima ratio stultorum."

We learn that the Rev. C. Spurgeon has vouchsafed to express his "loathing" of vivisectionists.

Keller ("Vierteljahrschrift der Natur. Gesellsch. Zürich") gives the following proof of the existence of a well-developed colour sense among Mollusca. A sepia (*Eledone*) in the Naples Aquarium was fleeing from the pursuit of a powerful lobster. During its flight it appeared of a pale red colour. Next it placed itself upon a piece of yellow tufa covered with brown spots, and assumed both the yellow ground colour and the size and shade of the spots, with such deceptive accuracy that it could scarcely be recognised by the observer.

The apparatus employed by Prof. Abbe, of Jena ("Journal of Science," vol. iii, p. 375, 1881), for demonstrating the influence of diffraction spectra in the formation of the microscopic image, is now made by Herr Zeiss, and can be obtained through his agents. Although great pains have been taken, at the Royal Microscopical Society and elsewhere, to make known the pecu-

liar conditions under which the microscopic image is formed, very few persons have paid much attention to the subject. Like most old-established opinions, the dioptric theory of the microscopic image still holds its ground. It only needs the experiments to be seen to be convinced of the important bearings of Prof. Abbe's discovery. A few hours spent in observing the wonderful influence the diffraction spectra have upon the magnified image will do more towards banishing the old erroneous ideas than the mere reading of many elaborate optical papers. No one can read the abstracts of Mr. Stephenson, Mr. Crisp, or the few pages devoted to the subject in the last edition of Carpenter on the Microscope, and at the same time carefully work through the simple experiments there described, without greatly adding to his knowledge of what seems at first a hopelessly obscure subject. For the purpose of examining the diffraction spectra in a more effectual manner than the usual way of removing the eye-piece and looking down the tube of the microscope, Mr. J. E. Ingpen, Secretary of the Quekett Microscopical Club, places a small "*Ramsden*" eye-piece, suitably mounted, over the ordinary eye-piece: by this means the ocular is converted into a small telescope, and permits the condition of the diffraction spectra which are formed just above the back lens of the objective to be readily observed.

At the January meeting of the Royal Microscopical Society Mr. J. W. Stephenson gave the manipulative details of his process of mounting diatoms in phosphorus ("Journal of Science," vol. iii., Third Series, 1880, p. 733). He also gave an account of another effective medium for mounting objects to be examined with homogeneous immersion objectives. The new fluid consists of a saturated solution of biniodide of mercury in a saturated solution of iodide of potassium. The refractive index is 1·68, giving a difference of visibility over balsam, in the case of diatomaceous silex of 0·14, and of air 0·54. The object is mounted by spinning a circle of white wax on a hot slide. This cell is filled with the medium, and the diatoms attached to the cover placed upon it; a heated metal ring—*e.g.*, an old gun-punch—is then pressed down in the cover to squeeze out the surplus fluid and melt the wax round the cover. After washing, to remove all traces of the solution, a few coats of gold-size will permanently secure the preparation. This medium possesses the advantage of being reduced to any refractive index needed by dilution with water, and from its antiseptic properties would seem capable of preserving animal and vegetable tissues well; of course time only can decide its properties in this respect.

M. A. Colson ("Comptes Rendus") remarks that if disks of iron already partially carburetted are heated along with fresh disks, both absorb the same quantity of carbon if the diffusion of carbon in the metal is proportional to the duration of the

heating. To a given temperature there corresponds a constant coefficient of diffusion of carbon in iron. This law is only true when the iron is converted into steel. When cast-iron begins to be formed—that is a little before the iron becomes brittle—the absorption of carbon decreases. Silica ranks among the bodies most easily diffusible in carbon. By heating platinum in lamp-black containing 60 per cent of precipitated silica, we obtain a crystalline body, Si_2Pt_3, of the specific gravity 14·1, and melting at about the same temperature as common glass.

MM. Berthelot and Vieille, in a paper on the Speed of Propagation of Explosive Phenomena in Gases ("Comptes Rendus"), observe that the general mean speed of propagation in a tube, whether curved or straight, 0·005 metre in diameter, is 2810 metres per second. The material of the tube is indifferent. The speed is sensibly the same whether the tube is open or closed. The differences observed in tubes of different lengths fall within the limits of error. Under the circumstances of the author's experiments the speed of propagation of detonation—either with a mixture of oxygen and hydrogen, or of oxygen and carbon oxide—is independent of the degree of pressure. The introduction of an inert gas retards the detonation.